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JOURNAL
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OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGIST

VOL. 18 OCTOBER, 1925 No. 5

Proceedings of the Tenth Annual Meeting of the Pacific Coast Branch of the American Association of Economic Entomologists

The tenth annual meeting of the Pacific Coast Branch of the American Association of Economic Entomologists was held at Reed College, Portland, Oregon, June 18–20, 1925.

The opening and closing sessions were devoted to business meetings, while the remainder of the time was occupied with the presentation of papers, and discussions. Following the final meeting the Federal and State Entomologists met in the Second Annual Pacific Slope championship baseball game. After a riotous two hours the game was called in the fifth inning, when the score stood 24 to 12 in favor of the State men. On Friday evening a well attended dinner was held. On Saturday and Sunday an automobile trip was made up the Columbia river, the Hood river valley and around Mt. Hood. Stops were made at some of the wonderful scenic points, and for collecting. The night was spent at the base of Mt. Hood.

PART I. BUSINESS PROCEEDINGS

The meeting was called to order at 9:35 Thursday morning by Chairman Childs. Forty-nine members and visitors attended the sessions. The following members were present.

Back, E. A., Washington, D. C.
Bartlet, Oscar C., Phoenix, Ariz.
Campbell, Roy E., Alhambra, Calif.
Chamberlin, Thos.R., Salt Lake City, Ut.
Chamberlin, W. J., Corvallis, Oregon
Chapman, R. N., Minneapolis, Minn.
Childs, Leroy, Hood River, Oregon
Doane, R. W., Stanford University, Calif.
Downs, W., Victoria, B. C.
Dunavan, David, Toppenish, Wash.
Elmore, J. C., Alhambra, Calif.
Fisher, C. K., Alhambra, Calif.
Freeborn, Stanley B., Davis, Calif.
Herms, W. B., Berkeley, Calif.
Keen, Sadie E., Forest Grove, Oregon
Lane, M. C., Toppenish, Wash.
Larson, A. O., Alhambra, Calif.
Macdougal, Alice P., Toronto, Canada

Melander, A. L., Pullman, Wash.
Morrill, A. W., Los Angeles, Calif.
Mote, Don C., Corvallis, Oregon
Newcomer, E. J., Yakima, Wash.
Packard, C. M., Sacramento, Calif.
Reeher, Max M., Forest Grove, Oregon
Reeves, Geo. I., Salt Lake City, Ut.
Rockwood, L. P., Forest Grove, Oregon
Scullen, H. A., Corvallis, Oregon
Smith, Ralph H., Berkeley, Calif.
Spencer, A. J., Vancouver, B. C.
Spuler, Anthony, Pullman, Wash.
Stearns, H. C., Corvallis, Oregon
Van Duzee, E. P., San Francisco, Calif.
Van Dyke, E. C., Berkeley, Calif.
Wilcox, Joseph, Corvallis, Oregon
Wilson, C. C., Sacramento, Calif.
Wymore, F. H., Berkeley, Calif.

REPORT OF THE TREASURER FOR 1925

Balance on hand June 25, 1924			$12.32
Refund from Parent Association on 1924 expenses			14.48
Interest from bank			.67
Paid.—Postage	$5.65		
Mimeographing notices	4.00		
Dues, Pacific Division A. A. A. S	5.00		
Total expended		$14.65	
Balance on hand, June 18, 1925		12.82	
		$27.47	$27.47

Chairman Childs appointed the following committees:

Nominating: A. L. Melander, S. B. Freeborn, Don C. Mote. Resolutions: E. C. Van Dyke, E. J. Newcomer, M. C. Lane. Auditing: W. B. Herms, Thos. R. Chamberlin. Membership: L. P. Rockwood.

Final Business, Friday Afternoon

Chairman Childs called the meeting to order at 2 P. M. and asked for the reports of the following committees:

The auditing committee reported that they had examined the account of the treasurer and found it correct.

The resolutions committee presented the following resolutions:

Resolved: That, a vote of thanks be extended to Reed College for the hospitality in providing the Pacific Slope Branch of the American Association of Economic Entomologists with a meeting place and accommodations for its members and that the secretary forward a copy of this resolution to the president of the college.

Resolved: That, a vote of thanks be extended to our Chairman, Leroy Childs, for his untiring efforts in behalf of the Association and of its members in making this meeting successful.

Resolved: That, we express our appreciation to the parent association in sending Vice-President R. N. Chapman to address and participate in our meetings.

Resolved: That, this association express its sorrow for the death of Albert Koebele who died December 28, 1924 at Waldkirch, Germany. He was one of the pioneer economic entomologists of the Pacific Coast and the first to introduce insects for the control of injurious species on this coast.

The membership committee presented the following names which this Branch recommends favorable action on at the next meeting of the main association. E. A. MacGregor, O. S. McDowell, James Mills, Jr.

The nominating committee presented the following report:

Chairman—W. B. Herms

Vice Chairman—E. J. Newcomer

Secretary—Roy E. Campbell

The reports were all approved, and a brief statement of surprise and appreciation was made by Prof. Herms.

Dr. E. P. Van Duzee then spoke a few words in regard to the Pan Pacific Entomologist, the final issue of the first volume having just been issued. He appealed especially to all entomologists in the West to support the JOURNAL.

Afternoon Session, Friday June 19, 1925

The meeting was called to order at 2 P. M. Chairman Childs: "It is with great pleasure that I call on our Vice-President, Dr. R. N. Chapman, who brings us a message from President Gossard."

After expressing his pleasure at being able to be present, and commenting favorably on the informality, and freedom of discussions with which the meetings had been conducted, Dr. Chapman read the following letter:

LETTER FROM PRESIDENT GOSSARD TO DR. CHAPMAN

June 9, 1925

Dr. R. N. Chapman,
University of Minnesota,
Minneapolis, Minn.

Dear Doctor Chapman:

Allow me to express my great satisfaction that you are able to go to Portland. The American Association of Economic Entomologists needs at this time the counsel and assistance of this important Pacific Slope Branch in order to solve with any degree of satisfaction a number of important questions affecting the progress of entomology. I am, therefore, seizing this opportunity to obtain a preliminary discussion by a large group of entomological leaders of a plan which I shall submit at Kansas City next winter. I wish you to report to me what these western leaders think of my proposals, what criticisms are urged against them and what modifications or alternatives are proposed. My only chance to get a preliminary cross-section of opinion is through these Branch or regional meetings and I shall not be able to attend many, if any, of these.

Entomologists everywhere regard the Pacific Slope Branch as more nearly coordinate in numbers and importance with our General Continental Association than any other Branch is ever likely to become. The Pacific Coast Branch inherits some great traditions from the early workers of the West. It was here in the Western Branch

territory that during their lifetimes Koebele, Coquillett and Craw made their names household words throughout all the region and became known to entomologists all over the world. It was a brilliant chapter of entomological progress which they wrote. Biological control was exalted to the important place it now occupies through the signal success scored by the *Vedalia cardinalis* (now *Rodolia cardinalis*) as an enemy of the cottony cushion scale. The merits of hydrocyanic acid gas were learned at the same time, making possible the development of our vast federal and state systems for insuring clean nursery stock. Alexander Craw built up a quarantine and control organization so effective that it gave a great impulse to the development of similar organizations all over the world. Similar triumphs have been achieved in this same area by more recent leaders, most of them living. No other area has contributed more toward entomological victories during the past twenty years, no other is now working more fruitfully and we expect nothing better from any other area in the immediate future. The worthies of a past generation have been succeeded by leaders equally capable. I congratulate the Branch on its inheritance of such traditions of achievement, for the contributions it is constantly adding to our arsenals of information and for its future promise.

If any of us use such terms as parent Association or daughter Association to express the relationship of the Economic Association of Entomologists to the Pacific Slope Branch, we must think of a daughter full grown, clothed in the habiliments of mature womanhood and with the crown of matronly thought and of well considered purpose on her brow. I bespeak for the two Associations just such a friendship and just such an attitude of mutual helpfulness as a noble mother and an equally noble daughter may feel and render each to the other.

It is very probable that new Branches will soon be accepted for affiliation with our Continental Association. Some way must be found to relieve the congested programs of this Main Association and one way is for the Branches to receive for reading the surplusage of papers which can no longer be handled at the midwinter meeting. The day has long passed when there is any likelihood that we will have an insufficient attendance or an inadequate program at any general meeting, hence the formation of Branches and the holding of Branch meetings can no longer subtract in any important degree from the numbers or the interest in this International meeting. Many of the younger members who are unable to attend the General Association meetings can attend the Branch meetings. These territorial organizations are becoming numerous and important. The Cotton States Association of Entomologists has applied for recognition as an affiliated Branch and I hope will be admitted at our next annual meeting. If other Branches do not follow soon they doubtless will do so ultimately.

Our large membership and the distinct specializing tendency of present day studies must lead to important readjustments both in the features of our programs and in our business procedure. Symposia appear to be desirable as a partial ministry to our needs and these may be made to gradually pave the way toward final and inevitable sectioning of the Association. Entomologists especially interested in ecology joined hands some years ago with the plant men and organized the Society of Ecologists. If we do not recognize the need for the entomological physiologists, chemists, morphologists, extension men and other specialized classes to get together and discuss their common problems, we may be assured they will likewise organize independent societies to meet their requirements. It is simply a question as to

whether we will maintain an organic connection with these groups and furnish them with general guidance, or if we shall coldly ignore their rightful demands and permit, or I belive I may say, compel them to go off to themselves. They are asking for bread and I fear we are giving them stones.

It appears to me desirable that besides the two sections of Apiary and Horticultural Inspection, several others should be recognized as in process of evolution. Each of our members should be enrolled in one or more of such evolving sections, even if for some time to come such sections make no claim for a separate program in a room of their own. Each section can formulate some kind of policy, can define standards desirable of attainment and can organize some kind of supervision of its activities. Some of the leaders of each section should be organized as a Committee on Progress, which should keep in touch with new developments in their special field and stimulate and give general direction, so far as possible to progress in their special subjects. Each section should be expected to arrange one or more symposia at regular intervals annually, biennially or at other intervals but periodically. Individual papers naturally belonging to any particular section may, in many cases first be read at some Branch meeting and upon recommendation of the Branch, be put on the program of the Main Association. Five or more sections in addition to the two now in existence would have to be organized to include all the specialized phases of entomology mentioned by Dr. L. O. Howard in his important address of last winter on the "Needs of the World as to Entomology." This would make seven sections altogether, counting the two already recognized. A three days' meeting means six sessions, exclusive of evenings. It is, therefore, evident that not each of the sections could furnish a symposium for every meeting and I think this is not necessary. If we were to adopt a biennial plan, four of the sections could provide the program for one year and the other three the next.

Better yet, I think, would be the plan of organizing two or three of the sections within the Entomological Society of America if this Society will consent thereto, and the other four or five should be organized within the Economic Association. If our membership will consent to simultaneous sectional programs, each section can give one or more symposia annually besides reading a considerable number of individual papers, possibly all that are offered. By subdivision and assignment in each sectional Committee on Progress, every program can still claim 2 or 3 years for preparation. I am satisfied this will eventually be the accepted arrangement and I prefer it before any other. If simultaneous programs are not desired the entire program for one meeting can be assigned to two or three sections, A, B, and C, which may furnish symposia, individual papers, formal subcommittee reports, etc.; that is, whatever matter the Committee on Progress may choose, which will reveal the progress being made by this specialized section. The remaining sections, D, E, F, etc., should do their work during this year through the various Branch Associations which can probably receive all papers offered. The following year these sections, D, E, F, can furnish the Main Association program and sections A, B, C, can do their work through the Branch Associations. This will give each sectional committee two or more years in which to collect data, arrange symposia and perfect their programs. Such arrangements will prove very flexible to time requirements and there will be plenty of opportunity for discussion and question boxes. There can then be no excuse that not sufficient time has been allowed to get symposia ready and if any of the sections become impatient for more opportunities, instead of organizing

independently, they will merely ask for a room to themselves. By this means the Main Association will distinctly maintain her position of leadership, constantly encouraging further specialization which is synonomous with advancement, and will provide the main forum where the newest discoveries are announced and discussed. At the present time our programs are even more miscellaneous than in the Branch meetings and much less satisfactory because there is no time to discuss them. Each program is a crazy quilt to which each member contributes a little patch of his own, choosing as to color, weave and shape without any knowledge whatever regarding the kind of contribution his neighbor will make. The Branch Associations under this proposed arrangement will at once become important and furnish an additional outlet for that individual initiative which in the past has expressed itself through the main organization. Several of these branches are already as important in numbers and in productive research as the Main Association was 25 or 30 years ago.

As an example of the scope of activities which Section A, on Education, Extension, Organization and Cooperation may supervise, I suggest an outline somewhat as follows.—

This section should be specially devoted to the consideration of entomology as a necessary part of education or of nature study in rural schools, grammar schools, junior and senior high schools and all secondary schools; the inclusion of a well chosen entomological section in the *Boy Scout Manual* and in the publications of the Campfire Girls; to secure better than casual notice of insect subjects in such papers as the *Youth's Companion*, *Boy Life* and in the standard magazines which contribute most largely to moulding the world's thought. It should endeavor to increase the use of entomological toys and games and if possible add to the entomological education of the clergy and those religious orders which participate in large degree in the general education of the public. Simple entomological stories can be provided for juvenile Sunday School papers. There should be the warmest kind of encouragement for writers like Mrs. Comstock and Miss Patch, who can popularize insect studies for the young; we need a big crop of such writers. If fraternal organizers can find such rich, inspirational material in the Moose or the Elk for forming a brotherhood, what might not some enthusiast do who would choose for a fraternal emblem the Scarabeus, connected as it is with such rich, ancient stories of symbolism and mystery!

Besides considering this general training of the young this committee should deal with undergraduate and post-graduate courses of entomological study in our colleges and universities and with the adaptation of such courses to the needs of prospective farmers, professional men who may elect such courses on broad cultural grounds, and of those who contemplate professional entomological careers. Special attention should be given to desirable supporting courses, such as general zoology, botany, chemistry, physics, etc. Necessary equipment in teaching staff, apparatus and laboratories should be considered. This committee should also gather statistics regarding students taking entomological courses, the numbers who are specializing on particular phases of entomology, the number of teachers and investigators employed, and should summarize and review the information obtainable in regard to their compensation, etc.

The organization and operation of Departments of Extension Entomology in the states should be studied, as well as their achievements. Cooperative efforts and successes should be specially studied. Entomological use of the agricultural, city

and rural papers should be scrutinized and data collected regarding posters, lectures, news letters to county agents, entomological picture shows and entomological advertizing of all kinds

This committee should keep informed regarding all branches of the organization and secure some kind of organic affiliation with the various regional organizations of entomologists, state societies and entomological clubs. American entomology will advance most rapidly if it can speak as some sort of organized unit. In my judgment Section A can well have a joint committee from the American Association of Economic Entomologists and from the Entomological Society of America.

Only a brief outline is indicated for the remaining sections, none at all for some of them. Further study will doubtless lead to considerable changes in the grouping of subjects so as to logically relate them, and also changes may be made for the purpose of equalizing the importance of the sections. I believe I have outlined enough so the idea can be grasped.

Section B. This may be given over wholly to the Entomological Society of America which can make one or more sections of it, or part of the headings may be kept as Section B and the others given over to the E. S. A. (Committee on Morphology, Taxonomy, Geographical Distribution, Paleo-entomology, Embryology, Genetics and Evolution).

The scope of this committee's activities is fairly well indicated by the subjects listed and includes not only anatomical and morphological studies of both immature and adult forms of insects and their close relatives, but in addition thereto the natural history, in its broadest sense, of all the stages in the life of a species which can furnish any kind of clue to the correct placing of such species in a well-considered and, therefore, scientific system of relationships. Paleo-entomology, embryology and geography may be admitted as furnishing evidence of more or less weight in deciding such relationships. The committee will keep in touch with developments along these lines and furnish guidance so far as possible, encouraging desirable tendencies and discouraging undesirable ones. They are specially expected to devote time and effort toward stabilizing entomological nomenclature.

Section C. Physiology, Tropisms, Behavior, Psychology, Ecology.

Section D. Medical Entomology, Bibliography, Commercial Entomology, Insects as food for birds, mammals, fishes and humans; possible source of vitamins and endocrines.

Section E. Insect Control, natural control, parasitism, fungous, bacterial and other diseases attacking insects, meteorological influences, farm practice, chemistry and physics of insecticides, mechanical and electrical engineering as connected with insect control. Insect surveys, statistical methods, calculation of probable error, costs and appropriations, entomological economics, team work and cooperation.

Section G. Horticultural Inspection and Quarantine, Eradication, Legislation.

Section H. Apiculture.

Perhaps the working out of the plan will be best understood if I compare the Association to a one-room school in which 7 or 8 subjects are taught, the subjects in the Association being represented by sections. Each yearly meeting represents one day of school and five consecutive years a school week of five days. It is desired to have a recitation in each subject at least once per week or within the five year period, while the more important subjects like reading (corresponding to the section on Insect Control) must have a recitation once or twice every day, or at each annual

meeting. Other subjects may receive attention two or three times per week. If there are enough teachers and rooms, each subject can have a recitation every day or a sectional program at each annual meeting. This would mean working the vice-presidents as much as the president and having simultaneous programs. If the Entomological Society of America takes charge of part of the sections, and the programs of the two Associations do not overlap, it is as if one teacher were to conduct the school for the morning session but is replaced by another teacher for the afternoon.

The pupils elect their studies and each class decides for itself what the recitation shall be about. The difficulties begin when a large number of children want to elect every subject on the list and have a recitation in each every day, while others want only one subject and insist that practically the entire day shall be given to this subject; and if they are not accommodated they won't come to school. Some of our members are very childish in this respect and very blind to the situation which confronts the Association's officials.

Apparently a group of hard-headed "daddies" must grapple with this situation, staighten out the tangle and maintain some kind of system and discipline, even if some recalcitrants refuse to come to school every day.

I ask nobody to support this proposal but I do ask that the entire membership assist me in considering and debating the question and if this plan is not acceptable, that dissenting members try to formulate something better than this scheme and also better than our present procedure.

Having done the Pacific Slope Branch the honor of choosing her meeting as the place for the first discussion of this plan, I shall confidently expect from her members "first aid" in perfecting it or the suggestion of some substitute as good or better, which can be considered at the Kansas City meeting. I shall in all probability recommend that a committee be appointed from the Association of Economic Entomologists to consider jointly with a committee from the Entomological Society of America all plans that are submitted at Kansas City and to receive for six months or a year after the Kansas City meeting any additional plans which other members may wish to submit; and then that this joint committee of the two Associations be empowered to formulate a plan which they are ready to recommend for adoption to both Associations.

Sincerely yours,

H. A. GOSSARD,
President

Considerable discussion followed, with a diversity of opinions. However, the symposium idea was unaminously favored, but on the plan of further sectioning, if it involved simultaneous meetings of the sections, there was much opposition.

A motion was carried that the incoming officers constitute a committee, additional members of which would be appointed by Prof. Herms; this committee to take up President Gossard's suggestions thoroughly and prepare recommendations prior to the Kansas City meeting.

The meeting adjourned, to meet next year with the Pacific Division, American Association for the Advancement of Science.

PART II. PAPERS AND DISCUSSIONS

Morning Session, Thursday June 18, 1925

Chairman Childs: The program lists an address by the chairman, but I have decided to read a paper on the Possibilities of an Ovicide as an Auxiliary in Codling Moth Control.

POSSIBILITIES OF AN OVICIDE AS AN AUXILIARY IN CODLING MOTH CONTROL

By LEROY CHILDS, *Superintendent, Hood River Branch Experiment Station, Hood River, Oregon*

ABSTRACT

The control of the codling moth, *Carpocapsa pomonella* Linn., through the use of an ovicide for the first brood of worms is feasible as an auxiliary to arsenate of lead provided a safe and effective ovicide is found. The degree of benefit obtainable will depend largely upon prevailing temperatures during first brood activity. It is believed that two thoroughly applied ovicides during such years as 1923 and 1925 at Hood River, would have destroyed fully 75 per cent of the eggs of the first brood.

The writer is familiar with no 3 per cent oil spray that can be used with freedom of injury at the present time.

Oil sprays should be tested in the localities where they are to be used before they are generally recommended.

Though a vast amount on investigational and experimental work has been devoted to the study of the life history and to the control of the codling moth, *Carpocapsa pomonella* Linn., with stomach poisons, little serious study has been given the matter of combating the pest with an ovicide. It seems strange that a measure of this sort should not have been given more attention in sections where the codling moth causes much trouble, at least as an auxiliary to arsenate of lead in controlling this most serious apple insect. The lack of an effective agent for this purpose is probably responsible for the fact that this field has not been covered.

Our knowledge, not only if the manufacture of oil sprays has been greatly increased during the past few years, but their uses at different seasons of the year as well. Doubtless there is much to be learned in both fields. We are approaching a point where we find that certain oil sprays can be used with a relative degree of safety on trees in foliage. The introduction of summer oil sprays has introduced a spray material giving possibilities of assisting, at least, in the control of the codling moth. Several growers in the Northwest last season used oil sprays for red-spider control and reported favorable impressions relative to their influence in destroying the eggs of the codling moth.

In 1912, Safro (1) of the Oregon Experiment Station, demonstrated the fact that lime sulphur, employed at different strengths, was not effective as an ovicide for the codling moth. This work was followed by some observations of DeSellem (2) of Yakima, Washington, who used nicotine sulphate (Black-leaf forty) in sprays employed for the control of the codling moth. DeSellem's results, as determined by the condition of the fruit at harvest time, indicated that applications of nicotine sulphate used at the rate of 1–1024 and stronger in four applications reduced the damage caused by the codling moth. In this work it is not clear how results were obtained, the investigator states; "Just how or why nicotine serves to check the activities of the codling moth, we do not know. Our work has been in the form of carrying out a practical orchard demonstration." Apparently, the influence of the spray on the eggs was not determined, as no mention is made of such observations. In 1918, Lovett (3) applied Black-leaf forty alone at different dilutions and in combination with fish oil soap to codling moth eggs deposited on apples as a laboratory experiment. The results of these tests demonstrated that nicotine sulphate was effective as an ovicide, particularly so when combined with soap. No field tests were reported by Lovett. McIndoo, Simanton, Plank and Fiske (4) in 1921, reported the effects of nicotine sulphate as an ovicide on the codling moth from laboratory work conducted by McIndoo and from field work carried on at Benton Harbor, Michigan, Grand Junction, Colorado, and Roswell, New Mexico. McIndoo's laboratory tests differed from those of Lovett, in that an approximate 45 per cent kill was the greatest obtained—this at a dilution of 1–400. He carried his work somewhat farther than Lovett, placing newly hatched larvae on pears at intervals of 1 to 6 days after spraying. He observed that "about 75 per cent of the larvae tested were killed when placed upon pears which had been sprayed one or two days previously; also—that the mortality decreased to about 25 per cent on the sixth and seventh days." The results of the field tests were determined on the basis of clean fruit comparing the nicotine sulphate with regular applications of arsenate of lead. No data were presented, indicating the ovicidal properties of the material applied under field conditions. The authors offer the following conclusions: "According to the work conducted during the season 1917, it is shown that nicotine sulphate 1:800 with soap, gave a fair degree of control of the codling moth at Benton Harbor, Michigan, and at Roswell, New Mexico, but that it was not as effective as one pound of powdered arsenate of lead to 50 gallons of water; and also that there was no practical advantage in

combining arsenate of lead and nicotine sulphate in sprays designed to control the codling moth. At Grand Junction, Colorado, where the infestation was much heavier, nicotine sulphate 1:800 without soap, was inefficient against the codling moth."

More recently, Newcomer (5), 1924, made some limited tests both in the laboratory and in the field with oil sprays. In laboratory tests he reports control to the extent of 80 to 100 per cent with an oil spray containing ⅔ of 1 per cent lubricating oil. Two orchard tests were made by this investigator. In one test, a block of trees sprayed with oil during May and June along with the lead sprays, 82 per cent of apples were free from worms and stings, while an adjoining block employing lead only, had but 74 per cent free. In another orchard developing a serious worm condition, oil was applied at intervals of two weeks during July and August in addition to the lead sprays. The block sprayed with oil proved but 21 per cent free. Newcomer concludes as follows: "Evidently the oil sprays applied earlier in the season are much more effective than those applied in July and August. In both of these tests the usual lead sprays were put on in addition to the oil and I would not advise oil to the exclusion of lead arsenate until we know something more about it."

Though the writer has been studying the life history and behaviors of the codling moth for many years, (primarily for the purpose of establishing spray dates for apple growers of the Hood River valley), the possibilities of employing an ovicide to advantage did not occur to him to be of any great value until this year, (1925). Accordingly, some work was started which is hoped will add further to demonstrate the possibilities of an ovicide in handling the moth situation and also the place of an ovicide as an auxiliary to the regular lead applications in sections of severe infestation. The observations presented are, therefore, preliminary in nature, but at the same time should be of interest.

The successful use of an agent to destroy codling moth eggs depends largely upon three circumstances: First; do the moths deposit eggs at such intervals as would permit their destruction in sufficient numbers as to warrant such action with an economical usage of spray materials? Second; can these periods of heavy egg laying be definitely determined so as to be available to growers? and third; are conditions of weather and moth activity sufficiently typical in the different apple growing districts as to make observations in a certain district applicable to another?

It is a well established fact that the occurrence of temperatures of 60

degrees or above at sundown and thereafter, govern to a large extent the egg laying activities of the codling moth after this insect is in a condition to deposit eggs. The extent of infestation during any particular year is to a large degree governed by the number of days of such temperatures occurring during the life of the moths of the first brood. Summer temperatures during the life of the second brood moths, are usually always above 60 degrees so that natural factors, as related to temperature have little bearing on the seasonal variations in the prevalence of the pest. Successful control, therefore, depends almost entirely upon an understanding of all factors governing the activities of the first brood. At Hood River, the factor of temperature varies greatly, one season with another, and because of this situation, a seasonal study of these conditions must be made if economical as well as successful control is to be obtained. It costs roughly, $40,000.00 to apply a lead spray to the orchards of the valley. If these sprays are not timed for maximum results, the operation is far from economical to say nothing about its influence on control. Some years a spray applied ten days or two weeks after the calyx is the most valuable one during the season. During other years, a spray at this time would have no value whatsoever.

Temperatures alone, however, can not always be relied upon in the establishment of a spray date. Associated with this phenomenon, a careful study of the activities of the insects themselves must be made. Early in the season, quite often many days of favorable temperatures occur not accompanied with egg deposition. It is, therefore, essential that activities of the moths themselves be determined in the field at sundown at times of favorable temperatures in order to properly establish dates for spraying. Egg laying can be readily observed if conditions are right. Temperatures, late in the spring (late June) are often misleading. Their influence on egg laying is governed to a large extent by temperatures existing during May and early June. The occurrence of long periods of warm weather during this time brings out most of the moths, causing them to complete their egg laying at an early date. Intermittent cool and warm weather has a tendency to retard and scatter out emergence while very cool weather holds the moths back in large numbers. It is, therefore, necessary to keep up the study of moth activities throughout this period if growers are to be kept properly advised relative to their spraying activities.

Benefits resulting from the use of an ovicide will doubtless be confined to applications made for the first brood eggs. At this season of the year temperatures vary to such an extent as to permit, during certain

seasons at least, the deposition of relatively high percentages of the eggs during comparatively short intervals, making it possible to spray at intervals following such activities with the expectation of covering a comparatively high proportion of the total deposit. Second brood eggs as a rule are deposited regularly and quite uniformly over the total period of moth activity, and as a result, we find no peak in the deposit and a large proportion can not be hit without continually spraying. Incubation of first brood eggs as a rule, is much longer than is true of the second brood. At Hood River, 10 to 15 days are required for the hatching of first brood eggs with an average of approximately 13 days, while second brood eggs hatch from 5 to 8 days. A few well timed applications for the first brood would reach more eggs than several applications for the second.

In order to show the relationship of temperature to egg deposition and its bearing on a spray directed to destroy the eggs of the moth, a graph was prepared showing temperatures for the current year during which time the moths have been active—May and June. As has already been stated, 60 degrees F., at sundown appears to be the critical temperature above which egg laying occurs. The graph covered the temperatures for the hours 4 to 10 P. M., only. The probable limits during which time egg deposition occurs is 6:30 to 10:00 P. M., and as the days lengthen during June, 7:00 P. M., is the probable earliest period of activity. During warm, cloudy evenings, however, moths have been observed on the wing shortly after 6:00 P. M. Because of this factor the temperature line has been drawn from 6:30 P. M., to a point where it crosses the line of 60 degrees as the period of total possible activity. Just how long moths continue to deposit eggs after dark no data appears to be available. The writer very much doubts that this occurs after complete darkness regardless of the fact temperatures continue favorable.

During 1925 at Hood River, the first favorable temperatures occurred on the evening of May 12. Careful field observations indicated that no egg laying took place. On the evening of the 13th, moths were very active and eggs were found and tagged for observation. The charted temperature indicates that this situation was followed by several days during which time maximum conditions prevailed for egg deposition. But three days out of the fifteen days following, were temperatures too low for some deposition. Many eggs were deposited during this period. Careful attention was given the tagged eggs of the earliest deposition in order to establish the maximum limit for applying an ovicide. A 3 per

cent spray of Triona made from an oil emulsion manufactured by Balfour-Guthrie Company was applied. One block of trees was sprayed with oil alone and another block received in addition, arsenate of lead at the rate of 4–100. Numerous eggs were tagged on the trees before they were sprayed in each experiment. These eggs were located in various parts of the trees on both fruit and foliage and classified according to the stage of incubation, early, red ring, and black spot, that the influence of the oil might be noted. The following results were obtained:

TABLE 1. INLFUENCE OF OIL SPRAY ON CODLING MOTH EGGS

Experiment No.	No. eggs tagged	Condition of eggs	Number hatched	Percent Control
1. 3% oil emulsion	31	14 early 11 red ring 6 black spot	1 0 0	96.77
2. 3% oil 4–100 lead	22	1 early 9 red ring 12 black spot	2 0 0	90.9
3. Check	20	—	19	5.0

The orchard in which the tests were made was very wormy during 1924. The trees are large and at the time the spray was applied, were liberally supplied with eggs. It was estimated that many of them had a hundred or more unhatched eggs present at the time of applying the spray. A further study of the chart shows that two very favorable days for deposition occurred immediately thereafter, followed by a long period during which time temperatures were not favorable for egg deposition.

TABLE 2. EGG LAYING HOURS—CODLING MOTH, HOOD RIVER, OREGON

	1919	1920	1923	1924	1925
May 1	—	—	0	1	—
May 2	—	—	0	0	—
May 3	—	—	2	0	—
May 4	—	0	2	0	—
May 5	—	0	2	0	1
May 6	2	0	3	0	0
May 7	4	2	3	3	0
May 8	4	2	2	5	0
May 9	1	0	2	5	0
May 10	1	0	0	4	0
May 11	0	0	0	4	0
May 12	0	0	0	1	3
May 13	3	0	0	0	1

	1919	1920	1923	1924	1925
May 14	3	1	0	0	3
May 15	0	2	2	0	1
May 16	0	3	0	2	5
May 17	2	0	0	1	0
May 18	4	0	0	1	4
May 19	0	1	0	1	4.5
May 20	5	0	1	3	5
May 21	5	0	1	3	0
May 22	1	0	0	1	0
May 23	1	0	0	2	0.5
May 24	5	0	0	0	1
May 25	0	1	0	0	2
May 26	4	2	0	0	0.5
May 27	5	1	0	0	4
May 28	2	0	0	1	5
May 29	0	0	0	1	0
May 30	0	0	0	4	0
May 31	1	2	1	5	1
June 1	3	4	0	5	1
June 2	4	5	0	5	0
June 3	4	5	0	3	0
June 4	5	5	3	2	0
June 5	4	3	3	1	0.25
June 6	2	0	1	0	0.5
June 7	2	1	1	0	0
June 8	4	1	5	2	1
June 9	0	4	4	1	0.25
June 10	0	0	0	0	0.5
June 11	1	0	0	1	0.5
June 12	1	3	0	1	0
June 13	0	2	0	2	0
June 14	1	0	1	1	2.5
June 15	1	0	0	2	3
June 16	0	2	0	5	2
June 17	1	1	0	0	3
June 18	5	1	1	0	3
June 19	5	5	1	1	5
June 20	5	3	0	2	5
June 21	5	2	0	1	5
June 22	3	0	0	1	1
June 23	5	0	1	2	3
June 24	5	0	1	5	5
June 25	5	0	5	4	5
June 26	4	3	1	3	5
June 27	3	5	1	1	3
June 28	3	4	5	2	1
June 29	4	4	5	5	0
June 30	1	4	3	5	0
Total egg laying-hours	139	84	63	109	94
Total days of possible egg laying	44	31	28	44	38
Total days, number egg laying.	12	27	33	17	19

[1] Record not obtained.

Prior to the first application, or May 26, but 3 days occurred during which time temperatures were too low for deposition. Nine were favorable. (Table 2) During this period, a total of 23½ hours of proper temperatures existed between the hours of six and ten in the

evening. There was a further accumulation of 13½ hours above 60 degrees after the hour of ten o'clock, occurring on four days. Eighteen and one-half of the 23½ hours accumulated during a warm spell over a period of 5 days, May 15–20. During this short period, most of the eggs were deposited. In fact, considering the entire egg laying activities of the first brood, it is estimated that fully 75 per cent of the eggs were deposited then. The two days immediately following the applications of oil were very warm. Nine hours accumulated on these days followed by very cool weather and some rain. During the next nine days but 2¾ hours above 60 degrees were recorded. However, owing to the fact that the two very warm days had occurred since the oil application, it was believed advisable to cover the oil block again. Trees receiving lead and oil and arsenate of lead only, were not sprayed at this time as the covering was still good. The charted temperature also shows that following the application of June 6, continued cool weather prevailed, but 7¾ egg laying hours occurring up to June 15. During much of this time favorable temperatures existed for a few minutes only each day. As indicated by the activity of the moths, the warm weather occurring during the latter part of June came too late to greatly effect the total deposit.

Our temperature records are not entirely complete for the past 10 years, but those which are, have been tabulated in the accompanying table, (Table 2). This table indicates the total number of hours favorable to egg laying occurring during May and June. This was done for the purpose of determining whether 1925 was what is commonly called an "exceptional season" or not. The years tabulated are 1919, 1920, 1923, 1924 and 1925. Other years are not given because of lack of completeness of the record. The author's notes relative to egg laying are not sufficiently complete as to permit an analysis such as has been done for 1925. The temperature records indicate definitely, however, that during some years a safe, effective ovicide would greatly assist in checking moth activities and it seems to further indicate that an ovicide could doubtless be used to advantage during other years following periods of egg deposition. The year 1923, appears to be quite similar to 1925. Most of the favorable temperatures accumulated during three definite periods—one near the end of brood activities. Two completely successful ovicide sprays would have doubtless destroyed fully 75 per cent of the total deposit. Nineteen hundred nineteen was a very warm year, 44 of the 60 days were favorable for egg laying, with a total number of egg laying hours of 139. Many days during this year maximum condi-

tion for deposition existed. It is very doubtful whether two ovicidal sprays would have greatly reduced the total hatch. Nineteen hundred twenty might be considered a moderate year. However, the period occurring from May 31 to June was extremely favorable for deposition as indicated by earlier temperatures it is more than probable that a very appreciable percentage of the eggs of the first brood were deposited at that time.

TABLE 3. CONDITION OF FRUIT
Stings[1] June 10, 1925

Experiment No.	Material used	Apples counted	Total stings	Per cent stings
1	3% oil	500	6	1.18
2	Check, no spray	500	88	21.1
3	3% oil, 4–100 lead	500	6	1.18
4	2–100 lead, 1–100 Kayso	500	28	5.3
5	4–100 lead, 1–100 Kayso	500	25	5.0

[1]Wormy apples also called "stings" in this tabulation.

The elimination of "stings" is a matter worthy of consideration. Many growers consider a sting as bad as a worm. Destroying the eggs should materially assist in correcting this difficulty. Counts have been made in the sprayed block already referred to and the figures shown in Table (3) were obtained. That some benefit has resulted from the use of oil is quite apparent. The unsprayed check 21.1 (all moth injury is classified as stings at this time owing to the small size of worms present). Oil 3 per cent, 1.18 per cent stings; oil 3 per cent plus 4–100 lead, 1.18 per cent stings; lead 2–100 plus 1–100 Kayso, 5.3 per cent stings; lead 4–100 plus 1–100 Kayso, 5.0 per cent stings.

Little is known relative to the oil spray used. It is reported to be one being tested out for work on citrus in California. At 3 per cent some damage in the way of spotting the leaves has been observed. This condition, up to the present time, has not been of a serious nature. There appears to be less injury where combined with the lead.

This paper is presented not with the idea of establishing the fact that the author is convinced that an ovicide should be used for codling moth control at this time, but more to place the subject before you that it may stimulate further observation. Further, no general recommendations should be made with oil sprays at 3 per cent until their limitations are

rather definitely understood in the particular localities in which they are used.

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4. 1921—MCINDOO, et al. Nicotine sulphate as an ovicide and larvicide. Bulletin 938, U. S. D. A.
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A discussion followed, lead by Mr. E. J. Newcomer who emphasized the fact that there were many kinds of oils, giving various results from their use, both as to control and injury. Mr. R. H. Smith called attention to the use of oils in Colorado, where three years' trials by orchardists were unsuccessful. Much oil was used this year in the Yakima valley. The weather has been unfavorable for a heavy infestation of the codling moth, and it is expected that the percentage of wormy fruit will be small, but the use of oil will be given the credit, even though the weather is responsible.

Chairman Childs called for the following papers.

LIFE HISTORY, HABITS, AND ECONOMIC IMPORTANCE OF THE TAHITI COCONUT BORER, *DIOCALANDRA TAITENSIS* GUERIN.

By W. B. HERMS, *University of California, Berkeley, Calif.*

(Paper not received)

THE GOOSEBERRY ROOTBORER (*XYLOCRIUS AGASSIZII* LEC.)

By W. J. CHAMBERLIN, *Oregon Agricultural College, Corvallis, Oregon*

ABSTRACT

Reviews the literature, discusses earlier recommended control measures, states no satisfactory check is known and adds to the known life history.

Little has been written concerning this insect which was described by Leconte from specimens secured in California in 1861.

In 1898 we find the first reference to the borers as pests. During that year they were noted at Victoria, B. C. in gooseberry plants which had been imported from Salem, Oregon.

In the report of the Dominion Entomologist and Botanist, 1899, Fletcher reports the occurrence of Xylocrius in British Columbia, and gives the following comments on the life history as observed by Mr. Carew Gibson. Mr. Gibson reported that one larva transformed to the pupa stage August 19 and the adult emerged 18 days later, September 6, another adult emerged September 13, and one egg was obtained September 15. He also states that only a single larva is found in each bush.

Chittenden in Bulletin 23 (1900) in discussing this pest practically repeats what Dr. Fletcher reported and Professor Essig in his Injurious and Beneficial Insects of California gives essentially the same information. None of the data previously reported checks in any way with the results of our studies up to this time, as will be seen from the notes given below on the life history.

In the articles cited above, Essig recommends that the canes be cut out and burned to obtain control, and Fletcher and Chittenden suggest that infested plants be cut out and burned. As a matter of fact, neither of these methods are adequate as the borers will often work for several years in a plant and many adults may emerge without the plant showing any signs of infestation except the falling off in berry production. The burning of canes would get very few insects at any time since probably not over five per cent of the borers ever come up into the canes at all.

The production of gooseberries in Oregon has been carried on quite extensively during the past years, and has given the grower a high money return per acre so that the industry has spread constantly and a large amount of acreage has been brought into production. However, many growers have during the past three years been forced to pull out their entire patch or at least remove the older plants, which were so heavily infested that they no longer produced a crop commensurate with the care and cost of production.

In August 1923, the problem of endeavoring to work out means of controlling the Gooseberry Borer was undertaken by the writer at the Oregon Experiment Station. It was found to be too late to get data on the life history during 1923, so that little could be done except obtain clean and infested stock for planting in cages to be used later.

In April 1924, work was actively started and during the season many fields were visited, hundreds of plants dug up and examined, and quantities of infested roots placed in cages, but not a single adult beetle was obtained. Since adult beetles were quite common in 1923, and later proved to be numerous in 1925, it was concluded that the life cycle covered a period of at least two years, and that the adults appear in numbers only in the odd numbered years, 1923, 1925, etc.

The season of 1924 was devoted to trying out various insecticides applied at the base of the plants in the endeavor to kill the borers in the roots and crowns. A total of one hundred fourteen plants were treated, three substances being used in varying quantities and applied in various ways. The following tables show the results.

TABLE I.

Insecticide	Quantity	Date Applied	Date Examined	Larva Alive	Larva Dead	Condition of Plant
Paradichloride	½ oz.	April 7	April 21	2	0	OK
"	½ oz.	"	May 20	2	0	OK
"	½ oz.	"	May 20	1	2	OK
"	½ oz.	"	May 20	0	0	OK
"	½ oz.	"	June 1	5	0	
Calcium Cyanide	1 oz.	April 7	June 9	2	0	OK
" "	1 oz.	"	June 9	5	0	
" "	1 oz.	"	June 9	1	0	
" "	1 oz.	"	June 9	0	0	Dead
" "	1 oz.	"	June 23	1	1	Dead
" "	1 oz.	"	June 23	0	0	
Calcium Cyanide	2 oz.	April 7	April 21	1	1	OK
" "	2 oz.	"	May 20	5	0	Failing
" "	2 oz.	"	June 9	Not infested		Failing
" "	2 oz.	"	June 9	1	2	OK
" "	2 oz.	"	July 1	Not infested		
" "	2 oz.	"	July 1	2	2	Dead
Calcium Cyanide	3 oz.	April 7	May 20	1	1	OK
" "	3 oz.	"	May 20	4	2	OK
" "	3 oz.	"	June 9	1	3	Dead
" "	3 oz.	"	June 9	Not infested		Failing
" "	3 oz.	"	June 9	Not infested		Dead
" "	3 oz.	"	July 1	2	3	Dying
" "	3 oz.	"	July 1	0	1	OK
" "	3 oz.	"	July 1	Not infested		OK

Check plants: Fifteen plants selected from various parts of the field were examined July 1st to see if any larva were dead from natural causes. Plants which showed signs of infestation as evidenced by poor foliage and unhealthy appearances were chosen and fourteen of the fifteen contained borers, 81 living and one dead larva were found, giving an average of 5.8 larvae per plant. One plant contained fourteen living larvae.

TABLE II.

Insecticide	Quantity	No. of plants Treated	Date Treated	Date Exam.	Larva Alive	Larva Dead	Remarks
Paradichloride	1 oz.	6	May 12	June 23	23	0	All plants alive
Calcium Cyanide	1 oz.	6	May 12	June 23	19	3	All dead
" "	2 oz.	6	May 12	June 23	7	0	3 plants not infested, all dead
" "	3 oz.	6	May 12	June 23	9	4	1 plant not infested, all dead
Paradichloride	1 oz.	6	May 20	June 23	11	0	2 plants not infested
Crude Naphthaline	8 oz.	1	April 21	June 9	1	0	
" "	16 oz.	1	April 21	June 9	1	0	
Paradichloride	1 oz.	1	June 1	June 9	13	0	
"	1 oz.	1	April 7	July 1	1	1	
"	1 oz.	1	May 20	July 1	1	2	
"	1 oz.	1	June 1	July 1	4	2	
"	1 oz.	1	June 1	July 1	1	0	
"	1 oz.	1	June 1	July 1	5	0	
"	1 oz.	1	June 1	July 1	3	4	
Crude Naphthaline	8 oz.	5	April 21	July 1	1–7	0	
" "	16 oz.	5	April 21	July 1	Ave. 3	0	

Calcium Cyanide seemed to offer some hope of killing the borers but it also gave evidences of killing the plants. In order to determine whether this material might be applied in some way so as to kill the borer and not injure the plant, four plots of five plants each were selected and 2 ounces of Calcium Cyanide applied to each plant as follows:

Plot No. I. Material placed from three to five inches away from the trunk and well covered.

Plot No. II. Material placed as close as possible to the trunk and well covered with dirt. In this case, the cyanide was often in direct contact with the roots.

Plot No. III. Material sifted right into the crown of the plant and only slightly covered.

Plot No. IV. Material placed in a ring on top of the ground, three to four inches from the plant and soil heaped over the material.

All plots were treated June 23 and examination July 15 showed all plants in Plot II were dead and plants in Plot I were either dead or dying. Plots III and IV were not seriously injured, but no dead larva were found in the roots or crown.

Conclusions

Paradichloride benzine and crude naphthaline apparently have little or no effect upon the larva. Calcium cyanide gave a kill of 33⅓% but owing to the fact that when applied in sufficient quantity and close enough to kill, it also kills the plant, it was discarded as a control measure and all efforts in 1925 were bent toward working out the life history in hopes that some weak point might be found where the insects could be attacked easily and effectively.

The life history was not fully obtained, but some valuable data was secured.

Fully mature larvae were found in the roots and crowns of plants at Monroe, Oregon, from February 10th on. The first adult beetle was taken at Salem, Oregon, March 21st. Regular emergence commenced at Corvallis about March 25th and reached its height about April 5. Fourteen beetles were taken in about thirty minutes at Monroe on April 8, where they were crawling about on a pile of pulled up gooseberry bushes.

Copulation was observed on April 8th, and pairs were placed in breeding cages for observation.

At 2:20 P. M. April 9th, the female beetles became restless, traveling up and down the larger stems of the plants, constantly running their ovipositors out and in crevices and any irregularities of the surface. All roughened areas were carefully examined with both ovipositor and antennae. The first egg was deposited between a piece of dirt and the bark. The spot was examined several times with the antennae. Then the beetle turned around, inserted the ovipositor several times. She then remained motionless, except for the antenna, which vibrated constantly, for a full minute, withdrew the ovipositor, worked it out and in for one and one quarter minutes, then deposited the egg and retired to the ground for a few moments, then flew into the foliage of the plant where she remained for some time.

Observation on other females depositing showed that the same general process was followed in each case.

Eggs were deposited as a rule as near the ground as a suitable place could be found; in cases where the earth was loose around the stalk eggs were deposited entirely below the surface. In only one case was an egg found more than three inches above ground. In that case the egg was placed about ten inches high in a crotch. Eggs were deposited singly but in favorable places, the same or another female would some-

times later insert another egg or eggs so that ultimately there might be a cluster of three or four eggs.

When deposited, the eggs are transparent, milky white in color, but turn to a pale sea green in about 48 hours. There is then little change until the sixth or seventh day, when a small shrunken spot appears near one end and fine lines appear on the surface resembling very fine scratches. During the next four days the shrunken spot increases in area, and the egg becomes more opaque and the mandibles of the developing embryo become visible. From this time until the egg hatches, the larva seems to be restless, moving its head from side to side. The first egg hatched on April 28—nineteen days after being deposited. Unfortunately, the majority of eggs deposited in the cages were infertile and in only one case was the point of entrance of the larva observed. In that case, the larva hatched from an egg placed about one inch above the soil and it entered the plant at the base where it had means of supporting the body between the dirt and the stem.

The number of eggs deposited by females under observation varied from two to eleven with an average of 5.5.

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LABORATORY EXPERIMENTS WITH ARSENICALS IN THE CONTROL OF THE CODLING MOTH

By E. J. Newcomer, *Associate Entomologist, U. S. Bureau of Entomology, Yakima, Wash.*

Summary

The difficulty of obtaining uniform working conditions when making orchard tests for the control of the codling moth, *Carpocapsa pomonella* Linn., has suggested the desirability of more exact laboratory methods. The method of spraying individual apples and placing a given number of larvae on them has been employed in the investigational work reported in this paper. It is not possible to investigate all phases of codling moth

control by this method, but it is believed that certain comparisons may be more accurately made in this way than by means of field tests. It is to be understood that these tests show the effect of the various sprays only when freshly applied.

Almost without exception the addition of casein spreader to lead arsenate or to other arsenicals or combination sprays has materially improved the control obtained. The smallest amount of casein spreader used, ⅛ pound to 50 gallons, gave better control when used with lead arsenate than any larger amount tested.

Increasing the strength of the lead arsenate reduced the number of worm holes and generally increased the number of stings, the total number of blemishes being reduced very little.

A heavy application of lead arsenate, 1 pound to 50 gallons, produced somewhat better results than a light application of the same strength.

No appreciable difference was observed in the effectiveness of equivalent amounts of paste and powdered lead arsenate.

The addition of lime-sulfur to acid lead arsenate materially reduced its efficiency, but this reduction was overcome by the use of casein spreader with the combination spray. The lime in the spreader apparently prevents or retards the usual reaction between the lime-sulfur and the acid lead arsenate.

The addition of a lubricating oil emulsion containing soap produced variable results, the average being poorer than those obtained with lead arsenate alone. A lubricating oil emulsion with casein as an emulsifier did not have this effect, the control being noticeably better than that obtained from lead arsenate alone.

Zinc arsenite was not as effective as lead arsenate. Paris green, with lime or with casein spreader, produced results not quite equal to lead arsenate. Powdered calcium arsenate gave very poor control, although four brands were tested. A paste calcium arsenate equalled an equivalent amount of powdered lead arsenate.

The meeting adjourned at noon.

Afternoon Session, Thursday, June 18, 1925

Chairman Leroy Childs called the meeting to order at 2 P. M. and called for the following papers:

NOTES ON OIL SPRAYS[1]

By A. L. MELANDER, *Pullman, Wash.*

ABSTRACT

Many orchard trees have suffered heavily as a result of the severe freeze of December, 1924. Some fruit growers have ascribed the injury to the adoption of oil sprays. A tour of inspection through the Spokane Valley by representatives of the Washington Experiment Station absolved oil, properly used, from all blame. No correlation was found between the extent of winter injury and the use of oil sprays.

Caseinate spreaders detracted from the effectiveness of oil sprays when used experimentally on San Jose scale and on eggs of leaf-roller.

We have noticed several reports of injury to fruit trees attributed to the use of emulsions of lubricating oil. Naturally, with the increasing use of oil sprays such reports will become more common, but during this spring, both in the press and in letters coming to the entomologist's office, several reports of serious damage caused an investigation to be made.

A call to the F. W. Ransom orchard near Clarkston showed many trees just after blossoming time with foliage stunted in growth but with a profuse set of blossoms. The condition was particularly noticeable on Winesaps, with Rome Beauty second. The stunted foliage was attributed to the late dormant application of 4% lubricating oil, government formula. The Ransom orchard is on the brink of the plateau overlooking Clarkston, and has been well cared for, with irrigation, artificial fertilizer and alfalfa cover crop. A visit to a neighboring orchard sprayed with lime-sulphur instead of oil showed the Winesaps to have the leaves slightly more advanced. Another neighboring orchard, sprayed with Dormoil, showed the Winesap leaves at an intermediate stage of development. Mr. Ransom believed that the retarded growth of his Winesap trees was due to his use of the government formula of lubricating oil, applied too late for safety, and shot with too much force on to the trees. The application was made with Friend pump, at 300 pounds pressure, with spray guns.

One month later the Ransom orchard was again inspected. By this time the apple trees had all a full growth of foliage, and the earlier retardation of leafing was completely overcome. Mr. Ransom stated, however, that the drop of fruit appeared to be unusually heavy. A seedling cherry tree, which had been resprayed with oil, was half dead.

From these inspections there was nothing positive to indicate that the spraying with oil was responsible for the belated leafing of the Wine-

[1]Contribution 123 from Washington Agricultural Experiment Station.

sap trees in the Ransom orchard, the heavy dropping of young fruit, or the injury to the cherry tree. The severe winter preceding harmed other near-by cherry trees to an equal degree, although they had not been doubly sprayed. The abnormal condition of the Winesaps was logically the after-effects of an unusually severe winter, intensified in the Ransom orchard, but whether the developing factor was oil spray, or location at the brink of the plateau, or too careful attention to soil fertility and irrigation with consequent succulence to the trees in early December, can not be told from the data at hand.

The Spokane Valley has had several recent set-backs from winter injury. In mid-December of 1924, following a period of unusual warmth, the temperature dropped about sixty degrees in one day. Naturally, severe winter injury was anticipated, but many growers ascribed the checks to their trees this spring as due to their use of oil spray. Pear trees universally did not blossom, and often their foliage grew from adventitious buds. Many apple trees showed a killing of branches. Often the trees suggested the condition when winter cuttings are forced into growth in the greenhouse, with weak blossoms and stunted leaves. The death of many has been hastened by the very general prevalence of the silver leaf fungus. In the Otis district, where oil was rarely used, whole orchards showed almost complete destruction of buds in March, and by May the nearly dead trees had soured sap in the cambium.

Because of repeated complaints that the dormant spraying of 8% oil for leaf-roller was responsible for the injury a survey of the situation was undertaken by the Director, the Horticulturist, the Plant Pathologist, the Soil Physicist and the Entomologist of the Experiment Station, aided by the local fruit inspectors, the county agricultural agent and several experienced fruit growers. The only specific case of injury attributable to oil was found in the Billhorn orchard at Dishman. Here under five adjacent trees, three in one row and two in the next, the vetch cover crop was spray-burned, while these trees plainly showed by their accumulation of oil and dust that they had received the last drainings of a tank of broken emulsion. One branch on one of these oily and checked trees showed almost normal foliage, and an examination disclosed a less obvious coating, indicating careless application to this part. This orchard was neglected during 1924, receiving no irrigation that year. All the trees showed varying degrees of winter injury or winter kill. Anthracnose cankers are forming, and silver-leaf fungus is permeating probably all the trees. One of the visitors characterized

the place as a "wreck of an orchard," but there was nothing to indicate that oil spraying was a factor, except in the case of the five trees just mentioned that had received a full dose of oil from a broken emulsion.

Because of the prevalence of leaf-roller in the Spokane Valley oil is applied at 8% strength, which is double the concentration usually used in the scale districts. In one orchard it was learned that the oil, water and caseinate emulsifier had been placed together in the tank and sprayed without emulsification other than that brought about by the agitator. A visit to this orchard showed all the trees equally injured, irrespective of whether they had been sprayed by the watery portion or the oily portion of the tankful. The owner, Mr. Nichols, attributed the dying condition of the trees to the oil spray, but it is certain that those first sprayed from the tankful did not receive enough oil to cause shock, while those trees last sprayed, receiving an overdose, did not show any greater injury than the rest. The local fruit inspector, Mr. George, had visited this orchard in March, before the application of the oil spray, and he declared that the buds and cambium were destroyed at that date. It was evident that winter conditions and not oil spray was responsible for the weakened condition of this orchard.

Another of the cases investigated because of complaint of oil injury was the Livengood orchard at Pasadena Park. Oil spray had been applied in 1924 and 1925, and it was thought that the former treatment had weakened the trees so that they were more susceptible to the December freeze. However, neighboring orchards that had not been treated with oil showed winter injury to the same extent, so there was no basis for Mr. Livengood's assumption. In a part of the orchard the oil spraying was omitted this spring. These trees were distinguishable only in that the damage from leaf-roller was excessive.

An interesting and forceful demonstration of the importance of oil spraying was noted in the Vercler-Spooner orchard near Opportunity. The oil treatment was given at the last possible moment thought safe to the trees, when foliage was already appearing. A break-down in the pump and rainy weather caused about one-sixth of the orchard to remain unsprayed. This portion was entirely defoliated and the fruit crop completely destroyed by the leaf-rollers, while the oil-sprayed trees adjacent were in thrifty condition, with scarcely any evidence of leaf-roller work. Certainly there was nothing to indicate that the belated oil treatment had set back the growth, nor was there any connection between the extent of winter injury and spraying with oil.

The Lakin orchard at Opportunity is focusing much attention. An

injunction was issued restraining the district fruit inspector from spraying with oil because the trees were already leafing out at the time the compulsory spraying was ordered. Arsenate of lead at the rate of eight pounds to the hundred gallons was being used to check the hatching leaf-rollers, but the treatment was proving ineffective. Nearly all blossoms were destroyed by the larvae working in the inner calyx cup, and the older larvae were moving out over the leaves, unhindered by the quadruple strength poison. Mr. Lakin produced scores of witnesses ready to testify that oil spraying was dangerous; but the evidence simmers down to the fact that the losses of trees in the Spokane Valley date from the advent of oil spraying, neglectful of the more important fact that during this same period there have been several unusually severe drops in temperature to below the zero mark immediately following spells of great warmth.

As a conclusion from this tour of inspection of the relation of winter injury to oil spraying, the following statement was agreed to by the Experiment Station officials: No evidence has been found of general injury from the use of oil sprays properly applied. The only cases of injury observed that could possibly be assigned to oil were those directly traceable to an imperfect or a broken emulsion or to spraying after growth had started. This decision is of great importance, because the leaf-roller district would soon be at the mercy of its major pest if deprived of the use of oil. It is fortunate that winter injury is not magnified by oil spraying. The good done by oil in reducing insect infestation so greatly overshadows the harm from its misuse that oil spraying should not be hastily condemned.

However, to avoid trouble the following conditions should be met in spraying with winter-strengths of mineral oil.

A. The oil should be well emulsified. If the emulsion breaks more or less, which is a common happening with strong agitation and hard water, the oily scum must not be allowed to go on the trees.

B. The application must be made before flower buds become exposed. Even as a semi-dormant spray, oil may temporarily check growth. Neither this retardation nor the burning of the edges of unfurling leaves is serious, for recovery is to be expected after a few weeks.

C. Oil spray should not be applied in the fall of the year in northern orchards, nor in the spring until after danger of zero weather is passed.

The Effect of Adding Spreaders to Oil Spray

The advantages of spreaders are apparently so obvious that they have been generally accepted without question. They do spread a lead

arsenate spray beautifully. They do avoid blotching of fruit from late summer spraying. They do make it possible to use lime-sulphur with other materials hitherto thought incompatible. Many more things are claimed for spreaders, such as better wetting, better penetration, better adherence. Spreaders are said also to supply viscosity to the insecticide, thus holding a thick coating on the sprayed object, preventing the running off of spray from the upper surface of branches and avoiding excess drip. How much experimental evidence there is for the idea that spreaders either thin out the spray liquid or add to its viscosity, whichever is the desired condition, does not worry the promoter. Perhaps his security lies in the lack of such evidence.

This year we have had occasion to test the viscosity idea of caseinate spreaders on the San Jose scale and on eggs of leaf-roller. On both of these insects a double test was made, first on cuttings brought into the insectary during the winter, and later under orchard conditions. The spreader was used with the regulation lubricating oil spray. A brief summary of the results is here presented. Since the tests consistently support each other the conclusion can be drawn that spreaders live up to their name: they spread the spray thin, and a thinned-out contact spray loses effectiveness. The last word has not yet been said about spreaders.

TABULATION OF EFFECT OF ADDING CASEINATE SPREADER TO OIL SPRAY

A. Spraying for San Jose scale.

A1. Insectary Experiments. Per cent alive two weeks after spraying.

	Oil Alone	Spreader Added	
		1:100	2:100
W. S. C., Spray Stock, 2%	20	46	30
W. S. C., Spray Stock, 3%	8	19	45
W. S. C., Spray Stock, 4%	3	19	22

A2. Orchard Experiments at Clarkston, Wash. Per cent alive one month after spraying.

	Oil Alone	Spreader Added		
		1:100	2:100	4:100
W. S. C., Red Engine, 3.6%	.089	.42	.26	.26
Same, 1.8%, Resprayed	.011	.326		

B. Spraying for Leaf-Roller Eggs.

B1. Insectary Experiments. Per cent of eggs hatched.

	Oil Alone	Spreader Added	
		:100	:100
Combined average of tests of seven lubricating oils	.8	3.0	5.6

B2. Orchard Experiments, Spokane Valley

	W. S. C. Miscible Oil, 8%			Caseinate Oil, 8%
	Oil Alone	Spreader Added		
		1:100	4:100	
Per cent egg-masses showing hatch	1.7	8.8	19.0	19.0
Per cent eggs hatched	0.15	7.1	10.0	3.9

COMPARATIVE TESTS OF THE TIME OF APPLICATION OF INSECTICIDES USED IN THE CONTROL OF ROSY APPLE APHIDS

By Don C. Mote, *Oregon Agricultural College, Corvallis, Oregon*

(Paper withdrawn for publication elsewhere)

OBSERVATIONS ON *SYNETA ALBIDA* LE CONTE IN OREGON AND EXPERIMENTS FOR ITS CONTROL

By Joseph Wilcox, *Assistant Entomologist, Oregon Agricultural Experiment Station*

Abstract

The syneta leaf-beetle, *Syneta albida* Le Conte, appeared in the orchards at Corvallis March 20. By April 1, the beetles were more numerous than in any year previously observed. They confined their attack principally to apple and cherry trees at Corvallis. The injury to apples was mainly to the developing buds and blossoms; to cherries, to the leaves and developing fruit. No satisfactory control was obtained for apples. One application of lead arsenate (5–100 plus 5 pounds of hydrated lime) before blossoming gave nearly perfect control on cherries. In orchards which have never been sprayed for this insect before, the results indicate that a spray of lead arsenate (4–100) be applied before and after blossoming the first year and one application before blossoming in succeeding years.

The syneta leaf-beetle (*Syneta albida* LeConte) began to make its appearance in the orchards at Corvallis, March 20, 1925. By April 1, the beetles were very numerous in the orchard and remained in large

numbers until April 20, from which date they rapidly disappeared, the last pair being seen May 21. Mr. Dennis Cooter, foreman of the college orchard for a number of years, expressed his belief that the beetles were more numerous this year than they had ever been before. A quick shake given to a limb of an apple tree in the college orchard brought the insects to the ground like rain drops.

Apples seemed to be the preferred host of this insect at Corvallis although cherries and filberts in the immediate neighborhood were also injured. A careful observer in the Salem region states that cherries and Bartlett pears are preferred by the beetle over prunes, peaches, and apples in his neighborhood. These last observations were partly checked by the author.

Injury

As soon as the insects appeared in the spring they began to feed on the unopened buds of the apple and cherry. On apples the beetles preferred the buds and blossoms to the leaves. When the buds had opened the beetles fed on the petals and were found more numerous in trees that were in full bloom than in trees that had already dropped their petals. The injury to apples seems to be entirely confined to the buds before and while opening and eventually a number of buds are killed in this manner. This would be especially injurious to newly grafted trees.

On cherries in addition to eating the buds and blossoms, the beetles nibble the developing fruit, leaves, and fruit stems. The injury later, on nearly ripe fruit, shows itself as a shallow, rough, calloused scar. Such fruit is docked by the canneries at Salem anywhere from 15 to 30 per cent. The injury to the fruit stems may be serious as some were found eaten nearly clear through. No scars that could be attributed to the beetles were found on apples in orchards that had early in the season been heavily infested with this insect.

Spraying Experiments—Apple

Sprays of lead arsenate (4–100 and 8–100) put on a number of apple trees while the buds were just beginning to show pink, failed to check the insects at all. Thirteen dead beetles were found on a canvas spread under a tree sprayed with lead arsenate (8–100) while none were found on the canvas under a tree sprayed with lead arsenate (4–100). In both trees the beetles were still very numerous and were eating the buds with the same voracity as before.

In the laboratory, beetles confined in cages with apple twigs sprayed with lead arsenate (4–100 and 8–100) were killed 100 per cent and the

foliage was but slightly injured. Twigs used as a check were badly eaten, practically defoliated, and only 3 per cent of the beetles were dead at the end of three days when the results were checked. One hundred beetles were confined in each cage in these tests.

A four per cent nicotine dust made up of hydrated lime and nicotine sulfate applied to beetles on apple twigs in the laboratory, killed 100 per cent of the beetles in 10 minutes (temperature 70 F.). A two per cent dust similarly made and applied under similar conditions did not kill any of the beetles immediately and at the end of two days 20 per cent of the beetles were dead and the foliage was badly eaten.

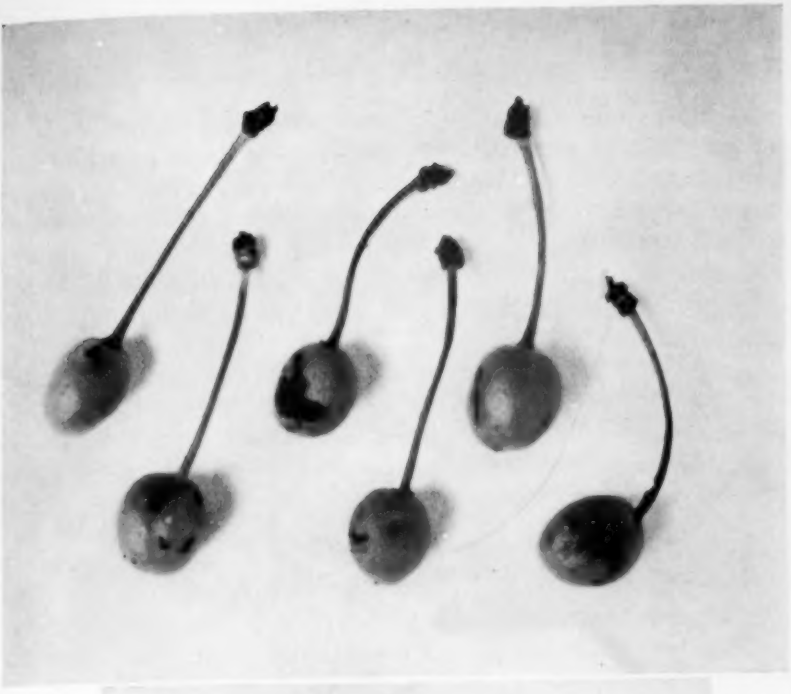
One tree in the orchard was dusted with a similar four per cent dust. The dust was applied on a morning which was cloudy and foggy with no wind and considerable dew on the tree. Insects were numerous on the tree but did not try to fly away when the dust was applied. The canvas was soon sprinkled with beetles that were sick but not dead. Five hours later (one o'clock) when the sun was shining but with considerable breeze, 72 dead beetles were picked up from the canvas. However, beetles were still active and very numerous on the trees. These may have flown in or may not have been killed, probably the latter.

Spraying Experiments—Cherries

The experiments on cherry trees at Salem were outlined by Professor Mote and applied under the direction of Mr. Knight Pearcy of Salem. On May 17, Mr. Pearcy and myself checked up on the experiments by counting at least 200 cherries in each sprayed and check plot. Cherries were very scarce on the trees and it was estimated that it would be unprofitable to pick this season.

Table 1. Results of Spraying Experiments at Salem for the Syneta Leaf-Beetle on Cherries, 1925

Spray Formula	Time of Application	No. of Application	Per cent of fruit injury
Lead arsenate 5–100	Before blossoming	One application 3 years in succession	4%
Calcium arsenate 5–100	Before blossoming	One application	14%
Calcium arsenate 5–100	After blossoming	One application	28.1%
Lead arsenate 5–100	After blossoming	One application	12.4%
Check—adjacent to above sprayed plots			61.3%
Lead arsenate 4–100	Before and after blossoming	Two applications	7.1%
Lead arsenate 8–100	Before and after blossoming	Two applications	6%
Check—adjacent to the above sprayed plots			37.5%



1. Injury to cherries by the syneta leaf-beetle (natural size).
2. Cherry leaves injured by the syneta leaf-beetle (one-half natural size).

An equal amount of hydrated lime per pound of poison was added to each spray solution. In the original outline, Professor Mote recommended a calcium arsenate dust and not the calcium arsenate spray, but as Mr. Pearcy had no dusting machine available he applied the calcium arsenate as a spray. The plots sprayed with calcium arsenate showed serious foliage injury, most of the leaves being burnt along their margins. No foliage burn was found in the lead arsenate plots.

Conclusions

Efforts to control the beetle on apple were unsuccessful as the beetles seem to be repelled by the sprayed foliage and only eat the rapidly growing portions which are untouched by the poison solution. When compelled to eat sprayed foliage, lead arsenate (4–100) killed 100 per cent of the beetles.

On cherries one application of lead arsenate applied before blossoming and in successive years gave the best control. In orchards untreated before, one application before and one application after blossoming gave nearly as good results. Double strength lead arsenate gave only slightly better results than single strength (4–100). In orchards which have never been sprayed for this insect before, the results indicate that a spray of lead arsenate (4–100) be applied before and after blossoming the first year and one application before blossoming in succeeding years.

The meeting adjourned at 4:45 P. M.

Morning Session, Friday, June 19, 1925

Chairman Childs called the meeting to order at 9:30. The following papers were presented.

FEEDING COWS INSECT-INFESTED COCOANUT MEAL

By R. W. Doane; *Stanford University, Calif.*

Abstract

Much of the copra-cake that is shipped from the Orient is more or less seriously infested with insects, the most important of which is the cigarette beetle, *Lasioderma serricorne* Fab.

Feeding experiments showed that dairy cows would eat the cocoanut meal made from infested copra-cakes as readily as that made from uninfested cakes and that there was no difference in the amount of milk produced, nor the total solids, butter fat or proteins, when the cows were fed on the infested instead of the uninfested cocoanut meal.

Chemical analysis showed that there was no difference in the meal highly infested with insects and that uninfested, as regards moisture, proteins, fats or acidity.

Copra-cake is a by-product in the manufacture of cocoanut oil. After expressing as much oil as possible from the copra by passing it through roller presses, the next step is to subject the ground copra to hydraulic pressure. The copra-cake resulting from this treatment is usually about eighteen inches square and from three-fourths to one inch thick. It weighs about eight pounds and contains 8 or 10% of cocoanut oil. During the past few years thousands of tons of these copra-cakes have been imported into the United States where, on account of their high nutritive value, they are rapidly becoming a favorite cattle food, particularly in dairies. In some instances the cakes are simply broken and fed to the cattle, but most of it is ground and fed as cocoanut meal.

On account of the scarcity of vessels during the war, quantities of these copra-cakes accumulated in the ports of the East Indies and in the Philippines, and when this began to arrive in San Francisco in 1919 and 1920, much of it was found to be more or less seriously infested with insects. The question as to whether this in any way affected the food value of the cocoanut meal that was made from the infested cakes, soon arose, and the Entomology Department of Stanford was called on for an answer to the question. Preliminary investigations indicated that the only way to secure a satisfactory answer was to conduct a series of experiments on a large enough scale so there could be no question as to the validity of the results obtained. An importing company in San Francisco agreed to furnish all the infested and uninfested copra-cakes needed,—a dairy located on the campus kindly allowed us to use as many of their cows as necessary,—and so, with the cooperation of the Department of Chemistry, the experiments recorded below were undertaken.

Insects Found in the Copra. Probably 98% of the beetles found infesting these copra-cakes were the cosmopolitan and omnivorous cigarette beetles, *Lasioderma serricorne* Fab. The beetles and their larvae were found most commonly in the edges of the cakes. Occasionally they would be found near the center but when the cakes were packed close together, as they usually were in the bags in which they were shipped, the middle portions of the cakes were not found infested. The cakes on the tops of the sacks were most apt to be infested, but sometimes the infestation was general throughout the sack. Thousands of bags of the cakes representing different shipments from various places, were examined and it was decided that much of the infestation must have taken place before the cakes were loaded on board for shipping. The slow sailing vessels on which this material is shipped take from two to four months or longer to make the trip and as much of the

time is spent in the tropical regions the conditions are ideal for the beetles to continue their growth and reproduction.

Both the beetles and the larvae, while they are feeding, make irregular channels through the cake reducing some of it to a fine powder, so there is always some dust when the insects are abundant. In this way, of course, they destroy more or less of the food material, but the amount lost was too small to be detected in the usual process of weighing and the usual loss in handling the material was much greater than the loss in weight due to the work of the insects. When fully developed the beetles come to the surface, probably to breed. This accounts for the fact that we often found more beetles on the outside of the sack than inside. Sometimes the sacks and the floor of the warehouse immediately around them would be covered with the beetles.

The saw-toothed grain beetle, *Silvanus surinamensis* Linn., the confused flour beetle, *Tribolium confusum* Duv., and the rust-red flour beetles, *Tribolium ferrugineum* Fab., were more or less common in some of the lots. The red-legged ham beetle, *Necrobia rufipes* De Geer, was also seen occasionally but it was not abundant. The last species did not seem to be attacking the copra but they were probably feeding on the larvae or dead beetles or other insects found around the copra-cakes. In tropical regions this species is commonly known as the "copra bug" because it is so common around boats and warehouses where copra is stored.

The Feeding Experiments. In selecting the material to be used in the feeding experiments, we took a ton from a lot in which there were practically no insects in any of the copra-cakes, and had it ground and sacked under our direct supervision. We then selected a ton of the worst infested material that we could find and had it ground and sacked in the same way. These two lots were sent to the dairy barn where the experiments were to be conducted.

For the first experiment a group of twenty high grade Holstein cows was selected and divided into two sections of ten cows each. These cows were all milking so heavily that it was necessary to milk them three times a day during the time covered by the test. In addition to their regular basic ration, group one, known first as the test herd, received three pounds of the cocoanut meal that was heavily infested with insects. Group two, known as the control herd, received exactly the same amount and kind of food except that the cocoanut meal was from the uninfested lot of copra cakes. At the end of fourteen days, the feed for the two herds was changed about, and group two became the test

herd and received the infested meal, and group one that had been receiving the infested meal, now received the uninfested meal and thus became the control herd. The experiment was then continued for eight days longer, making a total feeding period of twenty-two days.

It is a well recognized fact that any disturbances of metabolism of cows, reacts very quickly on the quantity and quality of the milk, and it was assumed, therefore, that if the cocoanut meal was distasteful to the cows or if it contained any toxic properties, the effect would bedetected by a comparison of the amount of milk produced and upon its chemical composition.

An assistant was present at each of these milkings, at 4 a. m., at noon and at 8 p. m. He checked the weighings made by the milker in charge of each herd and took a sample of 35 c.c. of milk from each cow at each milking. In addition to this he took a herd composite sample by taking 1 c.c. of milk for each pound of milk given by each cow in the herd. The composite samples were sent directly to the laboratory where they were measured into appropriate vessels for the determinations. Since there is so much normal fluctuation in values from a single cow, the individual cow samples were placed in the same bottle for a period of five days and preserved with a few drops of tolouene. It will be seen, then, that we had two sets of samples for study, one set representing the quality of milk for each cow for each five day period, and one representing the quality of milk for each herd for each day. Careful tests were made for butter fat, total solids, and protein content. The chemical tests were made by T. P. Hughes and R. J. Cross under the direction of Dr. R. E. Swain of the Chemistry Department.

Results of First Set of Feeding Experiments. Several of the cows that were used in this experiment were giving much more milk than others in the same herd, and it so happened that three or four of these heavy milkers were in the herd that was first fed the infested cocoanut meal, so that the average amount of milk given by this herd, both when it was receiving the infested and when it was receiving the uninfested meal, is higher than the average amount given by the other herd. Without giving the figures for each day for each herd, we may say that herd number one during the fourteen days that it was used for a control, started with an average for each cow of 46.83 pounds of milk per day and ended with 40.17 pounds, the average for the period being 44.45 pounds. During the eight day period that this herd was receiving the infested meal, the average pounds per day was 40.63, starting in with 40.51 pounds and ending with 40.67 pounds. Herd number two started

in as the test herd, receiving the infested meal, with 60.63 pounds of milk for the average of the herd for the first day of the test, and 59.48 for the last day, with an average for the period of 61.14 pounds. When this herd was changed and made the control herd and received the uninfested meal for eight days, the amount of milk given dropped from 59.33 on first day to 54.68 on the last day, with an average for the eight days of 59.38 pounds.

As two of the best producers in this herd were sold the day before the experiment ended it would be fairer to take the average for the seven days instead of eight. Revised in this way the average for this herd while on uninfested food would be 59.33 pounds at the beginning, 58.41 at the end, and an average of 60 pounds for the seven day period.

An analysis of the figures for the daily average production for the two herds shows that herd number one dropped approximately six pounds during the fourteen days that it was fed on the uninfested meal, and reached a level which it sustained during the eight days it was fed on infested meal. Herd number two held practically the same level throughout the whole test. This shows that the cocoanut meal made from the copra cakes that were badly infested with insects had no effect whatever on the amount of milk produced by the cows to which it was fed.

A close watch was kept to determine whether the food which contained the infested meal was as palatable as that which contained the uninfested meal. No difference could be detected in the way in which the cows ate or cleaned up the food made with the two different meals. The cows all remained perfectly normal in every respect throughout the experiment and a study of the records for each individual cow shows that there was no toxic action or abnormal fluctuation in any cow that would be covered up in making the herd average.

The chemical study of the milk showed that the protein content was rather irregular throughout the period covered by the test, but that there was no evidence of any difference in protein content whether the cows were receiving the infested or uninfested meal. It showed also that the butter fat was also fairly constant for each herd throughout the test. As would be expected the herd that produced the most milk produced a lower per cent of butter fat, but there was nothing to indicate that the butter fat production is influenced in any way by feeding the infested food. The total solids, as would be expected, showed the most variation, the per cent depending to a large extent on the amount of water taken by the cow. There was, however, nothing to indicate any difference due to the feeding of the infested meal.

The following graphs will summarize the production, fats and proteins for each herd during the period of the test. The solid line repre-

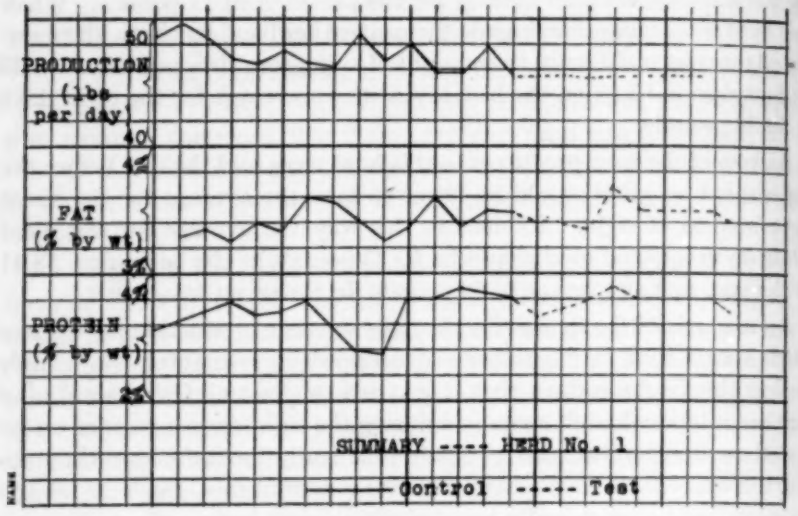


FIG. 15.—Summary of herd No. 1.

sents the time the herd was used as a control, the dotted line the time it was used as a test, i. e., the time it was receiving the infested meal.

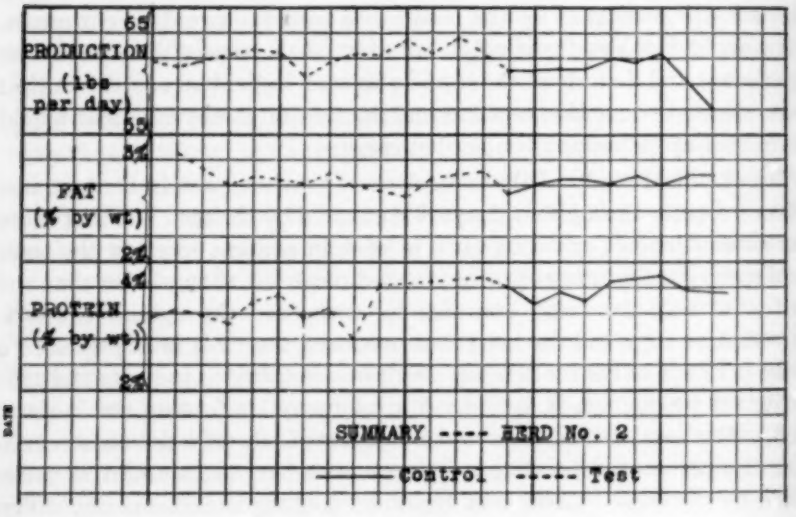


FIG. 16.—Summary of herd No. 2.

SECOND FEEDING EXPERIMENTS. In the experiment recorded above the beetle-infested cakes were ground just as they were taken from the bags and although they were selected from the worst infested lot that we could find many of the cakes would have but few beetles toward the middle, even though the edges were badly infested. After completing the first experiment it was decided to make another test in which the meal used should be made of only the badly infested parts of the cakes. A lot of badly infested cakes were selected and the parts that contained the most beetles and larvae together with the excreta in the burrows, were trimmed off and ground. To the meal made in this way several quarts of beetles, some alive but most of them dead, were swept from the floor of the warehouse and mixed with the meal. This was the meal that was used in the second feeding experiment.

For this test, six cows, all in about the same stage of their period of lactation, were selected. Two were used for controls, the other four served as the test animals. The ration fed during this experiment was made up as follows: 5 lbs. dried beet pulp, 3 lbs. dried oats, 3 lbs. wheat bran, 9 lbs. oat hay, 25 lbs. corn silage and 9 lbs. uninfested cocoanut meal. The test cows received the same ration for the first four days of the test, then for five days the badly infested meal, obtained as described above, was substituted for the uninfested meal, and then for another period of three days they received the uninfested meal again. The milk from each cow was carefully weighed and samples taken at each milking.

A study of the milk production records shows that all of the six cows made a slight gain in the amount of milk produced during the time of the test, at no time dropping below the amount they were giving when the test began, and the chemical tests made showed that there was no difference in the per cent of butter fat or in the refraction index of the butter fat or in the protein content or total solids during or after the period of the tests.

CHEMICAL COMPARISON OF INFESTED AND UNINFESTED MEALS. During the course of these experiments studies were made of the feeding values of the cocoanut meal and many tests were made to determine whether there was any appreciable chemical difference in the food value of infested and uninfested meals. Without giving the details of any of these tests at this time, we may present the following table to show the averages of moisture, protein fats and the acidity of the uninfested and infested meals:

	Uninfested average per cent	Infested average per cent
Moisture	10.49	10.35
Protein (dry basis)	21.09	21.30
Protein (as sampled)	18.93	19.16
Fat (dry basis)	8.11	8.07
Fat (as sampled)	7.32	7.25
	c.c.	c.c.
Acidity	23.9	23.0

These results justified the assumption that there was no appreciable chemical difference between the infested and uninfested meal, and that they were therefore equal in feeding value and equal portions could be used in the feeding experiments.

THE ROLE OF THE BEAN STRAW STACK IN THE SPREAD OF BEAN WEEVILS

By A. O. Larson, *Associate Entomologist* and C. K. Fisher, *Junior Entomologist, Stored Product Insect Investigations, U. S. Bureau of Entomology, Alhambra, Calif.*

Abstract

The development and spread of bean weevils, *Bruchus obtectus* Say, are assisted by the methods and practices man has adopted in connection with the production and storage of beans. Beans remaining in straw stacks furnish a breeding place for many generations of weevils. They are potential sources of infestation for growing crops as long as the stacks remain.

Dr. Howard, in "The Needs of the World as to Entomology"[1] has beautifully shown that the multiplication of injurious insects is helped in a way by the very methods man has adopted in his civilized life.

Probably this is nowhere born out more fully than in the spread and multiplication of the common bean weevil, *Bruchus obtectus* Say, and the southern cowpea weevil, *B. quadrimaculatus* Fab., which breed in beans and cowpeas.*

These insects after adapting themselves to their particular hosts, have, through the channels of commerce, become pests of great economic importance the world over. Their ability to remain for long periods of time concealed within the beans during cold weather, enables them to be shipped long distances without being detected until after they have

[1]1925. L. O. Howard. The Needs of the World as to Entomology. Annals of the Entomological Society of America, Vol. XVIII, No. 1.

*In this paper "beans" will be understood to mean not only varieties of *P. vulgaris* but also cowpeas and other seeds in which these weevils breed.

reached their destination. Overland shipments of infested beans during the summer are means of spreading the weevils over long distances. While they are dependent upon commerce for their wide distribution, their power of flight aids in their local dissemination.

Important as is their wide distribution through commerce, it is relatively unimportant when compared with their local dissemination in bean growing sections and warehousing centers. In this they are materially aided by the very practices of those whom they injure most—the bean dealers and bean growers. In an earlier paper the writers[2] pointed out the possibilities of weevil development in, and the possible spread from neglected seeds in warehouses.

In this paper the writers purpose to show that the bean straw stack is very important in the spread of weevils.

Some beans are always lost in threshing. Sometimes beans are threshed before they are properly cured. Frequently threshing is begun in the morning before the dew has evaporated from the vines or before they are properly dried after rainstorms. In such cases many pods remain intact and there is a heavy loss of beans which pass out with the straw. These beans serve as breeding places for the weevils.

As early as 1922, one of the writers found that stacks of early bean straw served as a source of weevil infestation for the late crops in Chino, Calif., where beans were planted over a period of more than three months.[3]

The worst infested field that has ever come to our notice adjoined a stack of bean straw in which *B. quadrimaculatus* had been breeding freely from early September until the late crop was threshed late in November. However the importance of bean straw stacks as a source of weevil infestation for growing crops was emphasized in 1924 when a weevil control campaign was being conducted in the Chino district of California. During the summer the bean fields were studied and careful inspections were made for the appearance of weevils. About the first of August one infested field was located. Immediately a search was begun for the source of infestation. After inspecting sixteen nearby farms the only source of infestation was found to be beans in a pile of bean straw in Mr. C. J. Wire's cow-barn on the ranch where the beans were growing. This straw was fumigated after which the nearby maturing beans (stringless green pods, red kidneys, and blackeyed cowpeas)

[2] A. O. Larson and C. K. Fisher. The Possibilities of Weevil Development in Neglected Seeds in Warehouses. Journal of Ec. Ent., Vol. 17, No. 6.

[3] 1923. A. O. Larson. Bean Weevil Investigation in Chino District. California Bean Growers Journal. Vol. IV, No. 6.

were watched to note the length of life of the weevils in the field, the distance of their flight, as well as their selection of varieties and ages of beans for oviposition. At the time the different varieties or plantings were being threshed, Sept. 12 to Oct. 10, twelve piles of beans totaling 7011 pods were carefully examined and hand shelled, as recorded in Table 1. Eleven of these lots were found to be infested with weevils. When the piles of late beans were hand shelled not a pod was found to contain eggs and only two pods were found which showed weevil injury. It was later found that six weevils emerged from beans which showed no infestation at the time they were shelled. These late beans grew between the original source of infestation on the north and the two stacks of early bean straw on the south and on the west so it was impossible to determine definitely which was the greatest source of infestation. On Oct. 10, it was found that some weevils had emerged from beans in the south stack of new straw. Observations made at intervals in the field indicated that the new piles of straw were the only source of infestation for the late beans.

The straw in the barn was fumigated August 20. At that time weevils were very plentiful in the field. A few minutes search would be rewarded by finding several weevils at rest or ovipositing or excavating holes in which to oviposit. On Sept. 2, long and careful search was required before a single weevil was found. Earlier examinations in that field had shown that weevils preparing to oviposit usually contained from 10 to 25 or more eggs as is the case with young adult females. The one weevil found on Sept. 2, contained only four eggs. Repeated observations with *B. obtectus* as well as with *B. quadrimaculatus*[4] have indicated that the majority of eggs are laid early in the life of the adult and that at the later end of life only a few or no eggs are laid. This indicated that the one lone weevil was well toward the latter end of its life when found thirteen days after the straw had been fumigated. Careful search on later dates failed to show any adults in the field. Under laboratory conditions at that time of year the adults seldom live more than 15 to 19 days.

In this field where beans were grown from within a few feet of the source of infestation to a distance of three-eighths of a mile away, the infestation in the early hand shelled beans appeared to be inversely proportional to the distance from the source of infestation. This seemed to

[4] 1923. A. O. Larson and Perez Simmons. Notes on the Biology of the Four-Spotted Bean Weevil, *Bruchus quadrimaculatus* Fab. Journal of Agricultural Research. Vol. XXVI, No. 12, p. 609 to 616.

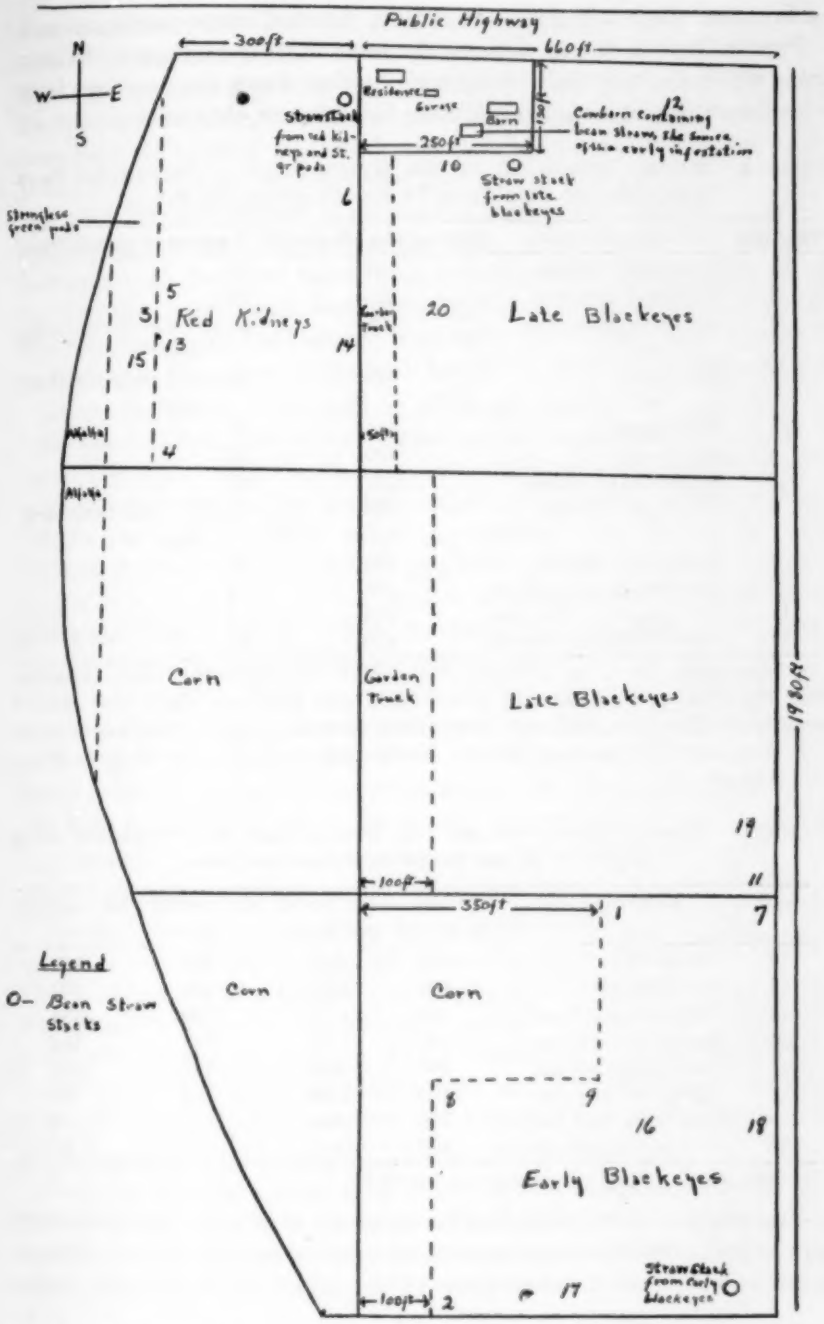


FIG. 17.—Location of Mr. Wire's bean fields in relation to the source of infestation. O indicates bean straw stacks. No. 17 was obtained from across the field. All other samples of threshed beans were taken lengthwise of the rows.

be born out when larger lots of machine threshed beans were examined.

Figure 17 gives the location of the bean fields in relation to the barn from which the weevils were flying. It also shows the locations from which the samples recorded in Tables 1 and 2 were obtained.

TABLE 1. WEEVIL INFESTATION IN MR. WIRE'S FIELD AS DETERMINED FROM HAND-SHELLED PODS FROM TWELVE PLACES IN THE FIELD[1]

Location	Kind of beans	Number of pods shelled	Number of weevils found
1	Blackeyed cowpeas	754	27
2	Blackeyed cowpeas	525	13
3	Stringless green pod	226	55 and 6 pods containing eggs
4	Red kidney	475	16 and 5 pods containing eggs
5	Red kidney	505	88
6	Red kidney	703	12
7	Blackeyed cowpeas	1127	27
8	Blackeyed cowpeas	378	6 and 1 pod containing eggs
9	Blackeyed cowpeas	914	0
10	Late blackeyed cowpeas	446	4
11	Late blackeyed cowpeas	508	2
12	Late blackeyed cowpeas	450	13

[1]The locations 1 to 12 are indicated on Figure 17. 3 ripened about two weeks earlier than the other early beans while 6 was taken from four rows which were about 1 week later than those adjoining. 9 was from vines which grew extra large but the pods were not well ripened at harvest. Each sample includes all of the pods on one pile of beans.

TABLE 2. WEEVIL INFESTATION ON MR. WIRE'S FARM AS DETERMINED FROM 8 LOTS OF BEANS TAKEN AT THRESHING TIME[1]

Location	Kind of beans	No. lbs. in sample	No. beans per pound	No. weevily beans	No. weevils
13	Red kidneys	100	1050	289	840
14	Red kidneys	100	1050	420	970
15	Stringless green pod	43	1050	909	3458
16	Blackeyed cowpeas	100	2130	115	182
17	Blackeyed cowpeas	100	2000	177	285
18	Blackeyed cowpeas	100	2000	42	47
19	Late blackeyed cowpeas	100	2025	8	8
20	Late blackeyed cowpeas	100	2025	31	39

[1]Locations 13 to 20 are indicated on Figure 17.

The beans, some of which had been planted as an early crop and others as a second crop following a crop of hay, were threshed on three different dates and in three different parts of the field. All three of the above

named varieties were included in the early crop but the late crop was only of blackeyed cowpeas. Seven hundred forty-three pounds of beans were purchased at threshing time from eight different parts of this field. Each bean from these different lots was carefully examined at intervals from Sept. 15 to Nov. 20. All beans showing evidence of weevil infestation were removed and recorded each time. These records not only indicated that the amount of infestation in the early crop was inversely proportional to the distance from the source of infestation but they also indicated that the early beans were two thousand times as weevily as the late ones when equal numbers of beans were considered. Because this field was somewhat isolated from other bean fields we were unable to find that any other fields had become infested from this source.

At the beginning of the harvest of the second crop or late beans another infested field was located. The source of infestation was found to be an old straw stack in which weevils were breeding freely. It had remained unprotected during the summer and preceding winter in Mr. Seitel's yard. This source, unlike the foregoing one, was in the very heart of the bean growing section and only a few feet from Mr. Seitel's field of ripening beans. It was too late to prevent infestation by fumigating the stack. Beans procured on the surrounding farms at threshing time showed that the weevils had infested fields at least one and one-fourth miles away. Here also the infestations were found to be heaviest near the stack in which the weevils were breeding. Figure 18 shows a map of part of the Chino district on which the locations of weevil infested fields are shown in relation to the known sources of infestation—two bean straw stacks and a pile of baled bean straw.

At threshing time another infestation was traced to a third straw pile which had remained until shortly before threshing.

Through the assistance of the four threshing crews operating in that section, and of the warehouse operators, samples or records of practically all lots of beans were obtained. The bean fields were platted on a map four inches to the mile. By checking our records with this map it was possible to locate the areas in which weevily beans had been grown. In this way an isolated infestation was traced to some bales of bean straw in which weevils were found to be breeding. While these bales were of unknown age they were probably two years old.

Early in April 1925, bean straw stacks in that vicinity were inspected for the presence of weevils with the following results. *B. quadrimaculatus* and *B. obtectus* were found breeding in beans in two stacks of bean straw which had been threshed the previous autumn. *B. quadrimaculatus*

were found breeding in Mr. Seitel's stack mentioned above. This stack had stood out in the open two winters and one summer. *B. obtectus* were found breeding in a stack of red kidney bean straw which had been in a shed three winters and two summers. Previous inspections indicated that this stack had become weevil infested only the last summer or autumn.

Late in April 1925, inspection showed that near Gridley, California, bean straw was stored in barns to be used for food for live stock. In two

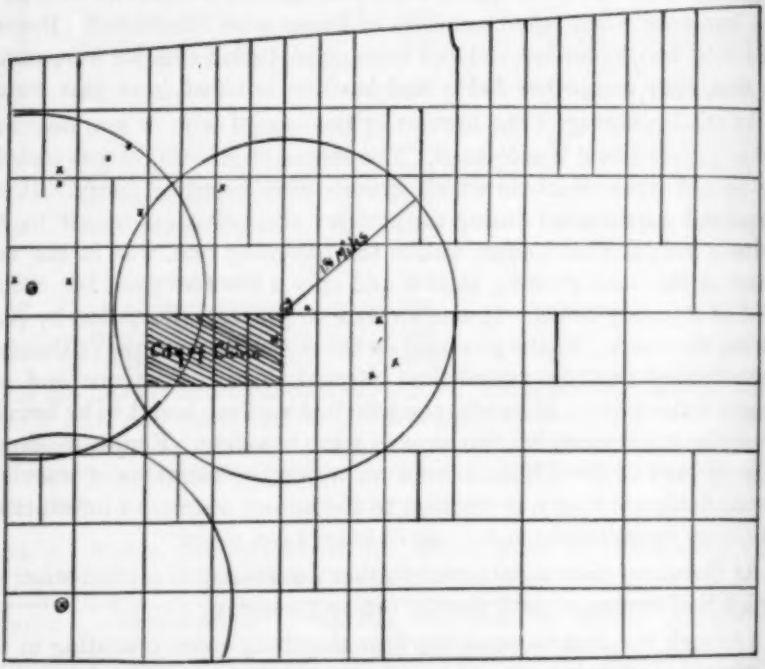


FIG. 18.—Map showing a part of the Chino bean district with the location of infested bean fields. X shows the location of infested bean fields and X in a circle known sources of infestation.

of these barns *B. obtectus* were found breeding in sufficient numbers to endanger the next crop.

Bean straw usually contains sufficient beans to serve as a breeding place for several generations of weevils. Because of the way the beans are scattered throughout the stack, thus making them somewhat inaccessible, they will carry an infestation much longer than the same number of beans would if they were in a bean bag where they could be more accessible. Because of the short time that adult weevils are able

to live, any place where they are able to produce several generations, becomes a potential source of infestation to growing crops and should be removed.

Bean straw stacks should be fed up or plowed under for fertilizer before planting time. Bean straw stacks or bales of bean straw should not be kept over summer in bean growing sections.

The paper was discussed by Messrs. Wymore, Larson, and Chapman, and the fact brought out that plowing under bean straw would destroy all the weevils, and also that weevils in infested beans which were planted would all die before pods were developed on the vines.

BAITING WIREWORMS[1]

By ANTHONY SPULER, *Washington Agricultural Experiment Station, Pullman, Wash.*

ABSTRACT

Calcium cyanide is an effective soil fumigant for the wet land wireworm, *Pheletes occidentalis*, but it is too expensive. Baits concentrate wireworms and when used in soil fumigation decrease the cost of treatment. Germinating seeds attract more worms and are more easily planted than other forms of baits.

The irrigated or wet land wireworm (*Pheletes occidentalis*) is fast becoming one of the most destructive insects to garden and field crops in the irrigated sections of the state. Soil examinations show that in areas reputed to have severe infestations the wireworm population varies from about 80,000 per acre at Toppenish, Wash. to 400,000 at Clarkston, Wash. Because of this severe infestation requests for practical means of control are becoming more persistent year by year.

Considerable work has been done on soil fumigation as a control for wireworms. Experiments conducted by Tattersfield and Roberts of Rothamsted, England, Dr. William Moore of the American Cyanamid Co., J. E. Neiffert of the U. S. Bureau of Chemistry and others show that there are a number of toxic substances that will kill insects of this type. Most of these fumigants will not lend themselves to soil conditions and can therefore not be used as soil fumigants. To be a good soil fumigant a material must have all or most of the following qualities: 1st, It must be highly toxic to insects: 2nd, it must not be dangerous to handle: 3d, it must not be readily adsorbed or broken up by the soil: 4th, it must not be unduly toxic to plants and 5th, it must not be ex-

[1]Contribution Number 122, Wash. Ag. Exp. Station, Pullman, Wash.

pensive. When these tests are applied to the various substances used in insect control all are found wanting. The one material that comes nearest meeting these tests is calcium cyanide. Calcium cyanide, however, is toxic to plants and altho the present price is as low as 15 cents per pound, is still too expensive to find general favor among the farmers. Recent investigations at Toppenish, Wash. have shown that at least 300 pounds of calcium cyanide are required to kill a high percentage of the worms in the soil under favorable conditions. This would cost 45 dollars per acre which is still too much of a tax to be considered by the farmer.

In June of 1923, investigations were carried on by the Division of Entomology of the Washington Experiment Station to determine if soil fumigation could not be supplemented by the use of baits in the control of the wet land wireworm. It has long been known that the Japanese gardeners depend on rice bran or rice flour baits to attract the worms away from the growing vegetation and to concentrate the worm to small areas where they can be dug up and destroyed. If the worms could be attracted from some distance in the soil the need for fumigating every foot of soil would be eliminated and the cost of treating the soil reduced. Accordingly various types of baits were planted in the soil among young nursery trees of the Washington Nursery Co. at Toppenish, Wash. The trees were at that time badly infested with wireworms and many of them had been killed outright. The baits were placed between the rows of trees and spaced four feet each way, thus forming the center of a circular area of about 12 square feet. After a period of a week the baits were examined for worms. The following table shows the results obtained in the use of the various baits:

TABLE 1. RESULTS OBTAINED FROM VARIOUS BAITS

Bait used	Av. No. worms per bait	Bait used	Av. No. worms per bait
Rice flour	26.6	Bran	22.5
Graham flour	26.6	Potatoes	17.3
Graham flour and sugar	24.5	Carrot roots	15
Graham flour and oranges	21.9	Carrot tops	8.4
Graham flour and lemons	20.1	Apples	8.4

The flour and bran baits were prepared by adding sufficient water to the flour to make a stiff dough. Since the original infestation in the nursery plot was found to be about two worms per square foot of soil, it seems that some of the baits proved quite effective in concentrating the worms.

In June of 1924 further investigations in the use of baits were carried on at Toppenish, Wash. by Mr. J. N. Stone of the American Cyanamid Co. and the speaker. A sugar beet field was used for the experiment. Prior to this time the field had been in beets but was plowed up because so many of the beets had been destroyed by the wireworms that only a few scattered beets were left. It was thought that this ground, because of its severe infestation, would prove ideal to try out baits. This did not prove to be the case. The freshly plowed ground dried out quickly and difficulty in getting irrigation water on the ground caused the worms to seek lower levels. The beet roots as well as tops that were turned down by the plow served as baits for the worms and fresh bait placed in the ground would not attract the worms away from the beets. In this experiment seeds of peas, beans and corn were planted in rows spaced six feet apart, by means of a garden seeder. Notwithstanding the fact that the beets themselves served as baits, many worms were attracted to the germinating seeds. It was thought, however, that many more would have been attracted had it not been for the beets which served as a counter attractant.

Wireworms are very fond of germinating seeds and will attack most garden vegetables while in that stage. For this reason any treatment of the soil would be most effective if applied before the regular garden or field crops are planted. In order to determine how early in the season this could be done, investigations were conducted at Clarkston, Wash. this year, beginning February 23. At this time most of the early garden in the vicinity had been planted but the soil was still cold and the wireworms inactive. None of the worms were found in the upper eight inches and very few were found in the upper twelve inches of soil.

Thru the courtesy of Mr. M. V. Pound of Clarkston, a plot of ground that had been used to grow a home garden for 26 years, was secured. Examination of the soil showed an infestation of approximately eleven worms to the square foot of soil. On February 23 Alaska field peas, garden beans and sweet corn were drilled in rows, spaced six feet apart, by means of a garden seeder. One row each of graham flour and potatoe baits was planted to check on the efficiency of the germinating seeds as baits. The graham flour and potato baits were spaced four feet each way.

Subsequent examination of the baits showed that the corn and beans did not germinate until March 13th and that wireworms activity did not commence until March 27th. When the wireworms did finally become active and work toward the upper few inches of soil, most of the

corn and bean seed had rotted. The Alaska field peas germinated early and the young plants were about two inches high and past the most attractive stage for the worms when worm activity began.

It was not until two weeks later that all the worms seemed near the surface. At this time all the baits were treated with calcium cyanide. Fifty pounds of calcium cyanide per acre was drilled in on one row by means of a garden seeder, but the garden seeder proved unsatisfactory since it did not place the cyanide deep enough in the soil to do effective work, so the remaining rows were treated by plowing a furrow close to the row by means of a hand plow. Where the hand plow was used the calcium cyanide was sprinkled in the bottom of the furrow at the rate of 100 pounds per acre and immediately covered by the plow. Where the graham and potato baits were used fumigation consisted in punching a hole in the soil over the bait by means of a hoe handle and placing one tablespoon full of calcium cyanide in each hole. The treatment of the graham flour and potato baits, as well as those rows of seedlings that received 100 pounds of cyanide per acre, proved to be 85% to 95% effective. The one row receiving but 50 pounds of calcium cyanide was only from 50% to 80% effective. Much of the poor showing in the case of the one row was probably due to the fact that the seeder did not place the cyanide deep enough in the soil. Four days after treatment with calcium cyanide, counts were made to determine the number of worms that had been caught at the baits. Similar counts from soil between the rows at this time indicated that all of the worms had not been attracted to the baits. To determine the number of worms not attracted by the first series of baits a second series was planted between the rows of the first. A week later the second series of baits was treated and checked. The following table shows the results obtained in the two series of baits used:

TABLE 2. AVERAGE NUMBER OF WORMS ATTRACTED PER SQUARE FOOT OF BAIT

Bait used	1st series	2nd series	Total	Worms per sq. ft. in soil after baiting
Alaska peas	43	19	62	2
Beans	41	20	61	1
Corn	43	22	65	1
Graham flour	75	—	75	4
Potato	22	—	22	7

The graham flour and potato baits were not renewed and that portion of the plot received but one series of baits. From this table it would seem that a high percentage of worms can be attracted to baits. The first series of baits would undoubtedly have attracted more worms had

they been in prime condition when wireworm activity was at its height. Had the first baiting been deferred until all wireworms were in the upper few inches of soil it is quite probable that further baiting would not have been necessary.

Baits for wireworms are most effective when planted during the height of wireworm activity. This is after the early garden is planted and before the soil becomes too warm near the surface to enable the wireworm to thrive in the first few inches of soil. Any plot of ground to be treated by baits in connection with calcium cyanide or with calcium cyanide alone must be used for some late crop such as potatoes. It is necessary when baiting a field to have it free from weeds or other vegetation, since this wireworm relishes such weeds as the Russian thistle and mustard. Baits should be allowed to remain in the soil for some time before treating with cyanide. It was found that more worms were attracted at the end of two weeks than after one week. One graham flour bait which had attracted 114 worms after two weeks attracted 45 more in another week. Calcium cyanide acts as a repellent and any bait so treated will cease to attract the wireworm.

The cost of baiting a field is not great. Two men can easily cover a field of five acres in a day. One hundred pounds of calcium cyanide is sufficient to treat an acre of soil where baits have been used. Germinating seeds prove to be the most efficient bait since they take less time to plant and attract more worms per foot than do the flour or potato baits.

THE HESSIAN FLY IN CALIFORNIA

By. C. M. PACKARD, *U. S. Bureau of Entomology, Sacramento, California*

(Paper withdrawn for publication elsewhere)

COMMERCIAL ENTOMOLOGY ON THE WEST COAST OF MEXICO

By A. W. MORRILL, *Los Angeles, California*

ABSTRACT

During the past few years the Mexican states of Sonora, Sinaloa and Nayarit, comprising the territory popularly known as the West Coast of Mexico have gradually assumed an intimate commercial relation to the western part of the United States. This has lead to the development of certain entomological work on a commercial foundation along lines adapted to the requirements of the situation. The writer has

been engaged to a large extent in this line of work in the region mentioned during the past four years and in order to create a better understanding of the relation of such work to the pest protection problems of the North American continent, a brief description is presented of the organization of the work and a brief review of some of the more interesting entomological features which have come under his observation.

Fuerte Valley Vegetable Growers Experiment Station

This station was established in the fall of 1921, with headquarters at Los Mochis, under a contract with the vegetable growers of the district. The special incentive to this action was the heavy damage suffered by the tomato crop from fruit worm attack during the previous season. Entomological work has been a special feature but a general program of experimental and demonstration work has been followed including, in addition, plant disease, fertilizer and cultural problems. The first season the writer was assisted by Mr. F. L. Yaw, formerly of the Division of Plant Pathology of the California Agricultural Experiment Station and during the past three seasons by Mr. A. H. Amis, formerly of the Bureau of Entomology of the U. S. Department of Agriculture. The development of the vegetable industry in the Fuerte Valley from less than 3000 acres during the season of 1920–21 to 12,000 acres during the season just closed, with a prospective increase to 20,000 acres for the coming season has lead to the demand from the growers for a corresponding increase in the experimental and advisory service. This will be supplied by September first which practically marks the beginning of the next vegetable season.

The Fuerte Valley in the state of Sinaloa is the principal vegetable growing district of the Mexican West Coast. The crops grown for export to the United States and Canada consist of tomatoes, peppers and peas. Out of approximately 1,317,000 lugs and crates shipped during the past season which ended soon after the middle of May, 1,239,000 were tomatoes. In the Fuerte Valley it is a common sight to see tomato fields 250 to 300 acres in extent and at least three companies have upwards of 1000 acres each. The financing of vegetable growing is almost entirely by American produce shippers and it is through them that the growers arrange for investigations, advisory services and community pest control campaigns, which constitute the functions of the experiment station. The expenses of this work are advanced by the shippers and at the close of the season are pro-rated among the growers on the basis of the number of boxes of vegetables shipped by each. For the past four years the work has cost an average of between fifty and seventy-five cents an acre per annum.

The United Sugar Companies

The United Sugar Companies, also located in the Fuerte Valley with headquarters at Los Mochis, the largest sugar producing concern in Mexico, since the summer of 1921 has maintained an investigation of sugar cane borers. For three years this was conducted by Mr. R. H. Van Zwaluwenburg who resigned in the Fall of 1924 and was succeeded by Mr. H. S. Osborn formerly of the Hawaiian Sugar Planters Experiment Station.

The West Coast Vegetable Committee

For the advancement of the interests of the West Coast vegetable industry the West Coast Vegetable Committee was organized by the Nogales (Arizona) Chamber of Commerce in January 1923. This committee includes representatives of the vegetable industry of the entire West Coast and its work is supported by voluntary subscriptions by the growers at a fixed rate for each car of vegetables which crosses the international line. Such subscriptions for the past season will represent more than ninety per cent of a total of about 3400 cars shipped. This is a remarkably high percentage for any cooperative action among farmers and would probably be hard to duplicate in the United States in any project in which even the smallest cash subscription is involved.

The most important features of the work of this organization are the annual survey of vegetable pests and the issuance of circulars of information on pest control, also the maintenance of contact on a scientific basis between the vegetable growing interests and the Federal Horticultural Board. As entomologist and plant pathologist of this committee the writer has given considerable thought to the question of the best method of functioning for the best interests of the vegetable growers of the West Coast.

The West Coast vegetable industry is virtually an extension of the vegetable industry of the southwestern United States, more than ninety per cent of the financing being done by concerns located in Arizona and California. These concerns in most instances have far more extensive interests in the United States than in Mexico and without exception do not ask for or desire any special favors or consideration in any way detrimental to the agricultural interests of the United States. On the contrary they want the privilege of importing into the United States only products which are not likely to introduce new pests. They want to know what pests exist which affect or may affect their products and

above all they, in common with vegetable growing interests of the United States are especially concerned with the question of excluding serious pests from other sections of the world.

To the writer falls no light responsibility in these matters. In the joint capacity of investigator for commercial interests and consulting entomologist for the Mexican Department of Agriculture and Development, he must do everything possible toward keeping informed in regard to pests which exist in the West Coast territory in order that no losses may arise from the discovery in vegetable shipments which reach the border at Nogales, pests which might necessitate refusal of admission to the United States. If anything of such serious nature exists or in the future is introduced to the West Coast section of Mexico, obviously the time to find it from the standpoint of commercial and growing interests, is before growers and others interested have invested hundreds of thousands of dollars in producing the crop for export. The interests of the vegetable growers of the United States and of the West Coast of Mexico are thus identical in essential features. An international line, regardless of efforts at inspection and quarantine, is obviously of very little or no protective value against many pests. It is important to the vegetable interests on both sides that everything practicable be done to prevent the introduction of new pests to any part of the North American continent. The vegetable interests of the West Coast of Mexico are giving serious consideration to such matters and are organized for active co-operation with governmental or other agencies which may be interested on both sides of the international line.

Camara Agricola Nacional del Noroeste de Mexico

In order to co-operate most effectively with both the Mexican and American authorities in quarantine and other protective measures affecting all agricultural products, there is now being organized on the West Coast, a Camara Agricola Nacional. This will represent commercial and agricultural interests throughout Sonora, Sinaloa and Nayarit. These West Coast states have been and are still well isolated from the interior of the country by means of a high mountain range with no passes practicable for the transference of agricultural products. Sugar and rice, for example, produced on the West Coast are shipped to the interior by way of the United States. This very effective barrier no doubt explains the absence of the pink bollworm, orange maggot and the avacado weevil from the West Coast. The vegetable growing and other agricultural and commercial interests are determined to do their

part in maintaining the benefits of this isolation even after railroad connections are established by the Southern Pacific railroad with the interior through Guadalajara.

Miscellaneous Investigations

In addition to the entomological work conducted by the organizations which have been discussed, miscellaneous surveys and investigations have been conducted during the past four years by the writer. A general survey has been made of the pests of the Yaqui Valley which is one of the most important agricultural districts of the West Coast. A beginning has been made in the study of West Coast cotton boll weevil conditions. Particular attention has been given to determining the variations in the habits and climatic effects as compared with the typical or humid form of the insect, also the comparative attractiveness of certain native wild cottons and the cultivated cottons.

Noteworthy Entomological Observations on the West Coast of Mexico

So far observed, with the exception of one of the cane borers there are no insect pests of major importance found on the Mexican West Coast which are not known to occur in the United States. The most notable entomological features of the West Coast consist in the absence or scarcity of certain pests contrary to expectations and in the differences in preferred food plants, habits and climatic adaptations as compared with the same species in this country. In one instance observations on the West Coast have lead to the discovery that severe damage to a vegetable crop in the United States has been overlooked owing to the confusion of two species in the larval stages. The opportunity for observations along such lines is a source of considerable scientific interest, even though made in connection with work for private interests rather than for the purpose of publishing contributions to economic entomology.

Among the Lepidoptera the following insects may be mentioned approximately in order of their economic importance on the West Coast; sugar cane borers (*Chilo loftini* Dyar and *Diatraea lineolata* Walker[1]), the common bollworm (*Heliothis obsoleta* Fab.) various species of cut

[1]Other cane borers recorded for the Mexican West Coast by Mr. R. H. Van Zwaluwenberg and Mr. T. E. Holloway are: *Chilo morbidellus* Dyar, *Diatraea grandiosella* Dyar, *D. canella* Hamps. and *Sacchorophagos mochisa* Schaus.

worms (undetermined), tomato leaf folder or, as called by Jones,[2] the egg plant leaf miner (*Phthorimaea glochinella* Zeller) cotton leaf perforator (*Bucculatrix thurberiella* Busck) and the beet army worm (*Laphrigma flavimaculata* Harvey). The cotton leaf worm (*Alabama argillacea* Hubn) is notable on account of its absence as far as the writer's observations go,[3] except in the state of Nayarit, near Tuxpan, in the fall of 1921. It would be expected that this would be an insect of common occurrence in Sonora and Sinaloa, but apparently it is no more so than in Arizona.

The bollworm is a serious pest of corn and tomatoes and during the past spring was notably destructive to peas by eating into the green pods, but during the past four years has shown practically no interest in cotton.

The name "egg plant leaf miner" given by Jones to *Phthorimaea glochinella* Zeller would not be the most appropriate one on the Mexican West Coast and apparently also in the Imperial valley of California. While this species has been bred from tomato leaves in the United States, its real economic importance has not been appreciated, judging from observations made in the Imperial Valley. The injury of this species to the leaves of tomatoes is of little importance but the fruit is subject to severe injury. The highest rate of infestation known was observed by Mr. A. H. Amis in the Imperial Valley in July, 1922, when 85 per cent infestation was estimated. Sixty days earlier when the insect was first observed in that section by the writer only a single specimen of the worm was found in the course of several hours' search.

The worms have undoubtedly been confused with young bollworms on account of the similarity of the habits in attacking tomatoes, but the two species may readily be distinguished. The tomato leaf folder, as it is called on the West Coast attains only about a third of an inch when full grown and is quite characteristically colored as described by Jones. The worm almost invariably enters the fruit at the stem end and rarely leaves the first tomato attacked even though it ripens. The bollworm or true tomato fruit worm on the other hand usually enters and destroys several green tomatoes in the course of its development and almost invariably leaves a fruit as soon as it begins to ripen. The leaf folder closes the entrance to its tunnel by means of a silken web and seldom penetrates deeper than a quarter of an inch into the fruit. While the direct injury by the worm to the fruit is usually not great, the in-

[2] Jour. Agr. Res., Vol. XXVI, p. 567, 1923.

[3] A destructive outbreak of this pest occurred in the Yaqui Valley in Sonora during August and September, 1925.

direct injury frequently amounts to between 25 to 50 per cent of the shipping crop. Infested tomatoes are culled out at the packing sheds as far as practicable and are a total loss while those which are missed by the sorters frequently develop Rhizopus, Oosporium or other infections before the shipments reach destination. These infections spread to otherwise sound fruits increasing the losses chargeable to the insect.

The worms appear in tomato seed beds early in the season, first as leaf miners, then as surface feeders protected by a characteristic folding of the leaf. The infested leaves are easily detected and much can be done to delay the infestation of the tomato fields by picking off and destroying such leaves before the tomatoes are transplanted. The potato is an occasional food plant of this species in Mexico so far as observed, the attack being confined to the leaves.

The beet army worm is frequently met with on the West Coast attacking various food plants but it is especially noteworthy as a pest of garden peas during the fall and winter months. It attacks the terminal buds and checks the development of the vines. It is frequently necessary to resort to control measures, the usual practice consisting of using ten to fifteen per cent of arsenate of lead and dry sulphur when dusting for mildew.

Among the Hemiptera two capsids, the garden flea hopper (*Halticus citri* Ashm.) and the humped-back melon bug (*Pycnoderes quadrimaculatus*) are notable pests. The former has destroyed several thousand acres of tomato plants in the Mexican West Coast section during the past few years. The latter is a destructive pest of cucurbits in gardens and is an ever present menace to commercial plantings.

In the Fuerte Valley Mr. Amis conducted a vigorous community campaign against the garden flea hopper during the past Spring, using calcium cyanide dust. This material is likely to cause injury to the plants if applied before the plants are thoroughly dry in the morning, or at any time on a cloudy day when the humidity is high or late in the afternoon of a clear day. The safe period is generally limited to between 10 A. M. to 4 P. M. and during this period in the Fuerte Valley there is usually a strong wind movement, the disadvantage of which has been overcome by using cloth covers supported by light wooden frames and applying the dust inside of these as they are pulled along the rows of plants.

The most notable observation in regard to the flea hopper on the Mexican West Coast is its lack of interest in alfalfa which Beyer[3] re-

[3]Bull. 964, U. S. Dept. Agr., p. 6, 1921.

ported as sharing in South Carolina the preference with cow peas and clover among the many known food plants. In Mexico, even where heavily infested tomato fields were abandoned and the plants completely destroyed by the flea hoppers, and where heavily infested fields were plowed under at the end of the season, adjoining fields of alfalfa have not suffered more than a light infestation. It is interesting to note that this pest has not so far been found in the Yaqui Valley which is located less than 125 miles north of the Fuerte Valley.

Repeated attempts to rear egg parasites of the garden flea hopper in the Fuerte Valley have given no results so far. The success of Beyer in South Carolina in rearing six species of egg parasites has led the writer to believe it is worth while to attempt to introduce such species of egg parasites as further investigations may show to be absent from the West Coast. To provide a foundation for this work the West Coast Vegetable Committee has appropriated $250.00 to be used for cash gratuities to graduate students or others for original investigations of the egg parasites of this pest. It is hoped by this means to direct attention to these parasites and to add materially to the list of known species which may be available as well as to secure information in regard to their comparative importance.

The humped back melon bug, or the "cassaba bug" as the writer called it several years ago in mentioning its injuriousness in Arizona,[4] is a serious pest of melons and cucumbers on the West Coast. It is very sporadic in its occurrence and it seems impossible to predict at what season it will be most destructive. In the Yaqui Valley it was very common and destructive in gardens in the fall of 1924 but was practically absent in commercial crops of melons in the spring of 1925. This pest, together with the melon aphis and downy mildew constitutes a group of hazards which make the success of commercial canteloupe growing in the warmer and more humid states of Sinaloa and Nayarit very doubtful. So far as known to the writer this pest is destructive to crops only on the West Coast of Mexico and in the Salt River and Yuma Valleys of Arizona.

Of the Thysanoptera only the onion thrips (*Thrips tabaci* Lind.) and the bean thrips (*Heliothrips fasciatus* Perg.) have been observed to be of special economic importance. The latter is a very common pest of garden peas and of cow peas but has not been observed on alfalfa or cotton.[6] In the Yaqui Valley, following the decline of pea vines in the

[4]Eighth Annual report of the Ariz. Comm. Agr. and Hort., p. 44, 1916.

[5]Jour. Econ. Ent., Vol. 14, pp. 373–374, 1921.

[6]Considerable damage was done to cotton in the Yaqui Valley in the summer of 1925.

fields at the end of the picking season, the bean thrips transferred its attention to canteloupes and accomplished about ten per cent damage to a commercial crop of seven or eight hundred acres.

The cotton boll weevil is the most destructive of the West Coast Coleoptera, if we count the losses due to the necessity for growing other crops in most sections of the Mexican West Coast. The largest cotton acreage on the West Coast at present is in the Altar section of northwestern Sonora, where there is a total of four or five thousand acres. The boll weevil has not yet been found in this district, although it is found near Hermosillo. In the Yaqui Valley the next largest plantings of cotton are found, amounting this season to about five hundred acres. South of the Yaqui Valley plantings of cotton are made from time to time, but are usually not successful on account of boll weevil attack, if made in any locality for two or more years in succession.

The West Coast weevils appear from physical characteristics to be a mixture of the typical *Anthonomus grandis* and the variety *thurberiae*. The situation is shown by the determinations made by Dr. Pierce from a series collected by the writer in the spring of 1921.[5] Eleven specimens from the Yaqui Valley collected four years ago tended strongly toward *thurberiae*. Ten specimens collected in the same locality in 1924 were considered by Pierce to be quite typical of *grandis*. From investigations so far made, the writer has proved the Yaqui Valley weevils well adapted to extremely high temperatures and moderately low humidity, conditions which would in all probability exterminate the typical *grandis* if these conditions could be duplicated in our southeastern states where the *grandis* form exists. On the other hand, the Yaqui Valley weevil does not exhibit the ability to aestivate inside the pupal cell as does the variety *thurberiae* found in the mountains and foothills of southern Arizona. It is the writer's opinion from his investigations to date that the weevils of the Yaqui Valley and other parts of Sonora are more closely related to the Arizona *thurberiae* than to the typical *grandis*.

Diabroticas are common pests on the West Coast, doing considerable damage to young crop plants of nearly all kinds. Dr. Schwarz has determined specimens of two species submitted as *Diabrotica variegata* Jacoby and *D. balteata* Lec.

Epilachnas have been found on cucurbits in Sinaloa and Nayarit. Specimens with spots on the elytra from Bamoa, State of Sinaloa,have been determined by Dr. Chittenden as *Epilachna borealis* Kirby, while specimens from Nayarit without spots have been determined by Dr.

Schwarz as *E. borealis* var. The so-called Mexican bean beetle has never been seen by the writer on the Mexican West Coast.

During the past four years grasshoppers have not been observed in destructive numbers anywhere on the Mexican West Coast. No dipterous pests of crops, worthy of note, have been discovered except a species of fruit fly which is sometimes found in guavas in southern Sinaloa and Nayarit. The orange maggot (*Trypeta ludens* Loew) and the papaya fruit fly (*Toxotrypana curvicauda* Gers.) apparently do not exist in the West Coast States of Sonora, Sinaloa and Nayarit. Considerable time has been given to searching for these pests in orchards and public markets without results. Termites are very destructive and as a consequence wood is not a popular building material. In the Fall of 1924 several wheat growers in the Yaqui Valley suffered severe local losses to wheat plants by a species of termite determined by Dr. Snyder as *Amitermes arizonensis* Bnks.

The order Homoptera is represented by only a few noteworthy species, the melon aphis being the most common and the most destructive. Although nearly always present on melon and cucumber plants the writer has never found it in injurious abundance on cotton. The California red scale (*Chrysomphalus aurantii* Mask.) is a common citrus pest in Sonora but is replaced in the more humid sections further South by the Florida red scale (*Chrysomphalus ficus* Ashm.). The purple scale (*Lepidosaphes becki* Newm.) is comparatively scarce, having been found by the writer in only one instance infesting a citrus tree and never observed on citrus fruits in the public markets. The soft brown scale (*Lecanium hesperidum* L.) and *Aspidiotus lataniae* Sign. (determined by Mr. H. Morrison) are found in rare instances infesting the fruit of the papaya but are not noticeably injurious. Generally speaking coccids are comparatively scarce in the region here considered.

Dr. E. P. Van Duzee. I might say that on a recent trip to the Gulf of California islands no specimens of the boll weevil were observed.

THE SYMPHILID, AN INJURIOUS GARDEN PEST IN OREGON

By B. G. Thompson, *Asssistant Entomologist, Oregon Agricultural College*

Abstract

During the past two seasons, 1924–1925, Symphilids—*Scutigerella immaculata*—have done considerable damage to garden crops in various parts of Oregon. Of the numerous soil fumigants and repellents used, none gave complete control. Corn soaked in bichloride of mercury solution (1–800), broadcasted and raked into the soil just before planting time gave good results.

(Withdrawn for publication elsewhere)

AN OUTBREAK OF *AGROTIS YPSILON* ROTT. ON OVERFLOW LAND IN WESTERN OREGON

By L. P. Rockwood, *U. S. Bureau of Entomology, Forest Grove, Oregon*

Abstract

The cosmopolitan cutworm, *Agrotis ypsilon* Rott., has occurred in destructive outbreaks on overflowed lands which have drained at a time favorable to oviposition by the moths. Such outbreaks have been recorded for the Gangetic Plain in India, the Wabash River Valley of Indiana, and the cranberry bogs of Massachusetts. A similar outbreak which destroyed a seeding of 200 acres of spring oats is here recorded for Western Oregon. The conditions leading up to this outbreak of June 1919 are described. Brief notes on the successful control of this outbreak by the standard bait method, the observed habits, natural enemies, fragmentary life history data, and a description of the larva, are included in this paper. It is concluded that similar outbreaks are likely to occur in future on lands overflowed in late spring in the Pacific Northwest.

Introduction

The Black Cutworm, *Agrotis ypsilon* Rott.[1] is well known as one of the ground feeding Noctuidae. It is a truly cosmopolitan species and has been recorded from all the faunal realms, and nearly all the life zones of the world, from the Holarctic to the Australian, from the principal islands as well as the continental masses. This cutworm is often a truck garden pest and has done damage to cultivated field crops such as corn, potatoes, cotton, and tobacco, and more rarely to grain and forage crops. Published records indicate that damage by this species may be said to be more or less chronic, varying somewhat from year to year, but seldom attaining the violent destructiveness of what we term an outbreak, that is occurrence in great numbers and without appreciable mixture with other species.

Recorded Outbreaks

Outbreaks, in this sense of the word, have occurred on lands which, having been overflowed, became drained of water at a time favorable to oviposition by the moths. Such outbreaks have reached tremendous proportions in India and have been recorded for the Wabash River Valley, in Southern Indiana, and the cranberry bogs of Massachusetts in the United States of America. Entomologists (3, 4, and 5) in India have studied outbreaks under these conditions, particularly on the so-called *tals*, overflow lands of the Gangetic plain, near Mokameh. They have observed a marked preference of the female moths of this species for oviposition on wet or muddy land directly after the recession of the

[1]Determined by Dr. H. G. Dyar of the U. S. National Museum.

water. As the moths are strong fliers it is believed that they may be attracted to such lands from considerable distances. According to Davis (7), in the Wabash Valley: "They invariably appear following a late overflow, that is on land which is overflowed and covered with water as late as early June." Franklin (8) recorded an outbreak in August on a Massachusetts cranberry bog that had been flooded from early June to July 10. The cutworms in this case were first seen about August 10 and disappeared about the 24th.[2] An outbreak of this species occurred in June 1919 on Wapato Lake in Western Oregon.

Outbreak in Western Oregon

Wapato Lake is an area of muck and peat soil situated in the southern part of Washington and the northern part of Yamhill counties. It is a basin of about 800 acres which is filled each winter by the back water from the Tualatin River, a tributary of the Willamette, and the run off from the surrounding hills. This basin was usually filled with water from the middle of November until about the middle of the following April, when the run off was aided by a powerful electric pumping station. The lake was at that time the property of one person who maintained a resident manager. In the fall of 1918, the lake did not fill up until December, later than usual because of the dry summer and fall. It was not drained until early May 1919, two weeks later than usual, because of the failure of electric power for pumping. About half the acreage was rented to several renters and land not used for pasture was plowed and planted as soon as the water had drained off. The principal crop was spring oats, about 400 acres in all. There was one large field of corn at the northern end of the lake on ground higher than the average and drained considerably earlier than the remainder of the tract.

The manager stated that the cutworms were first observed about the first week of June. The outbreak evidently started in the lowest part of the lake near the main drainage ditch. After the vegetation had been eaten to the bare ground here, the cutworms worked back toward the higher lands. Very few stragglers were found at any considerable distance from the main body. The older inhabitants of the vicinity recalled a similar outbreak of cutworms as having occurred about twenty years before. On that occasion the cutworms destroyed two seedings

[2] Franklin (9) has also recorded outbreaks of *Agrotis c-nigrum* Linn., *Cirphis unipuncta* Haw., and *Laphygma frugiperda* S and A., on the cranberry bogs under similar conditions, that is after late overflows.

of crops and no crops were harvested on the lake that year. In the outbreak of 1919, it was estimated that the cutworms took about 200 acres of the first seeding of oats before they were stopped. A good crop of oat hay was later harvested from that part of the lake which was reseeded in June after the cutworms had taken the first seeding. Very few cutworms were found in the corn on the higher ground and this crop was not appreciably injured.

CONTROL. This outbreak was controlled in the course of four or five days by broadcasting a poisoned bran bait of the formula: 25 lbs. bran, 1 lb. white arsenic, 1 qt. molasses, 3 lemons, and water. A small amount of Paris green was used in substitution for the white arsenic after the supply of that chemical was exhausted. No results from the use of the bait were observed for more than 48 hours after broadcasting. This slow working of the bait was attributed to low night temperatures on June 22nd and 23rd. It is possible that control of this species by the poison bait method might not be successful when the cutworms retain their strictly "cutting" habits as other workers report non-success with this method.

HABITS. The cutworms were mostly in the fourth stage on June 20th, some in the third and fifth stages. Some crawling on the surface occurred at all hours of the day where the ground had been eaten bare but large numbers were seen only after 3 P. M. In the morning most of the worms were curled up in the soil ½″ to 1″ below the surface. Heavy feeding was observed in the afternoon after 3 P. M. Most of the cutworms browsed on the oat leaves, which were only 3″ to 4″ tall, eating from the top down. One large larva, probably in 5th or 6th stage, was observed to cut off an oat blade and drag it into a hole in the ground there to be consumed at leisure. Wild mustard was eaten to some extent but the young and tender oats were preferred. Patches of a wild grass were often left practically untouched. The cutworms when traveling on the surface of the ground displayed no "army" characteristics but wandered aimlessly in any direction. They were very pugnacious when they met each other and a few mangled remains were seen, evidently remnants of cannibal feasts. About half of those collected were eaten by the others before the laboratory was reached two hours later.

NATURAL ENEMIES. Brewer's blackbirds, *Scolecophagus cyanocephalus* Wagl., Kill-deer, *Ægialitis vocifera* Linn., and some unidentified sparrows were observed to feed heavily on the cutworms during the afternoon hours. A crippled wild goose, left behind by its companions in their northern migration, had probably made away with some of the

cutworms. Tachinids, probably *Gonia exul*, were observed in the field. A few *Gonia exul* Will.[3] were reared from collected material in the latter part of July. The puparia were formed inside the cutworm pupae except in one case where they were formed in the skin of the full grown larva. *Sagaritis consimilis* Ashm.[4] was reared from a 3rd or 4th stage larva.

Life History. Our data on the life history of this species in western Oregon are very fragmentary. From the larger cutworms collected during this outbreak, pupae were formed from June 28 to July 4 and moths emerged from July 22 to July 28. Moths have been collected in the field on July 21 (1919), Aug. 1 (1919) and 22 (1917), Sept. 7 (1920), 15 (1920) and 17 (1919). Miss Sadie E. Keen, Junior Entomologist of the U. S. Bureau of Entomology, Forest Grove, Oregon, collected a pupa of this species in her garden on October 20, 1924. The moth emerged from this pupa, in a screened insectary, on Nov. 15, 1924. It seems safe to assume that moths were flying in early May 1919 when Wapato lake became drained of water. The indications are that there are two generations a year in Western Oregon. Gibson (6) has recorded moths as early as May 16 and as late as October 25, in Ontario, and considered that the species probably had two generations a year. Forbes (2) has stated that this species "is apparently, but not certainly, single brooded" in Illinois. Entomologists (4) in India have indicated two or three successive "broods" in the cool part of the year, with a period of six weeks to complete the life history in spring and "possibly" a month in autumn. They also observed that broods on different *tals* matured at different times. It is possible that the moths, being long lived and able to aestivate, may breed freely only when favorable conditions for oviposition are encountered. If this were the case, there would be no decisive line between generations and we would get scattered local colonies maturing at different times. This assumption would also explain Forbes' (2) observation that this species may be found in the cutworm stage at practically all times in Illinois.

Description of Larva. A description of the larva, prepared from immature larvae preserved in 70% alcohol, is given below:

General color above, dull dark greenish brown, dorsal area a little paler than sides; all lines very obscure, dorsal and lateral lines sometimes faintly indicated; ventral area paler uniform dull brownish green, thoracic and prolegs almost concolorous. Thoracic shield wrinkled, very dark, narrow dorsal line distinct; anal shield greenish brown with wide paired brown lines margining pallid dorsal line and covering most

[3]Determined by Dr. J. M. Aldrich of the U. S. National Museum.

[4]Determined by A. B. Gahan of the U. S. Bureau of Entomology.

of shield. Head wrinkled, mostly dark, frons, adfrontal area, epistoma, prelabrum, labrum, antennal and gular areas greenish brown with similar streak above ocelli, para-frontal bars very heavy and reticulations obscure, large dark irregular subocellar spot, trophi, except the strongly and sharply dentate mandibles, mostly greenish brown. Frons broadly and regularly triangular, adfrontal sutures attaining deep narrow triangular emargination of head capsule. Setae both on head and body, light brown, of medium length. Skin granules, prominent, convex, dark and shining very irregular in size and distribution, the larger ones conspicuous giving the larva its characteristic "greasy" appearance. Setal papillae prominent, convex, wrinkled, shining, on abdomen II two to three times as large as I, transversely oval, IV two to three times as large as III, IIIa not visible with low magnification, V and VI paler, about subequal in size. Seta IV varies but little in position, never as high as upper rim of spiracle, never below lower rim except on 7th abdominal segment. Spiracles large, black ringed, only slightly pallid, narrowly elliptical.

General form rather slender for a cutworm, of uniform width, subspiracular fold very strong. Riley (1) gave length of mature larva as 1.5 to 1.6 inches, and stated that there was considerable variation in the depth of coloring.

Conclusion

It would be well for cultivators of overflowed lands in the Pacific Northwest and entomologists to bear in mind that similar sudden and destructive outbreaks of this species may occur in future on lands which have been subjected to unseasonable overflow. The time of potential danger from oviposition by the moths of this species is not definitely known but may be expected to occur from near the end of April to late May or early June.

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A SUMMARY OF THE ANSWERS RECEIVED TO QUESTIONS ON THE MECHANICS OF SPRAYING

By E. R. De Ong, *University of California, Berkeley, California*

Abstract

An analysis of eighty-two answers to a questionnaire on spray mechanics is presented in tabular form. The replies cover almost every state in the Union and as they come principally from official entomologists, should indicate the trend of opinion on the important questions of pressure, rate of discharge and size of aperture in the disc. Several requests have been received for a summary of the replies so this means is taken of replying to all who may be interested.

A few months ago many of you received a questionnaire asking for your opinion regarding desired pressure and rate of discharge from standard spray pumps. These questions had arisen so frequently in California that it seemed desirable to get more information and hence the work was begun without realizing that a similar effort was being made through the Committee on Policy of this Association. I wish to thank those who so kindly responded, many at considerable length, in an effort to correlate our knowledge of the subject.

Table 1. Pressure Rates with Varying Factors

No. of replies	Pressure lbs.	Rod	Gun	Dormant	Foliage	Citrus	Remarks
3	100–150	1		3			Principally dormant work
4	175	2		4	1	1	Minimum for citrus
31	200–275	6	6	12	11	1	Lowest pressure usually with rods. Low for oil with rods,—low on peach, higher on apple.
24	300–375		7	2	14	4	300 lbs. thin lemon, 325 lbs. normal lemon.
5	400		3			4	For large trees, orange but not lemon

A digest of the replies received has been prepared in the form of four tables. It is fully recognized that questions of this nature are subject to such a great number of varying factors that it is difficult and sometimes almost impossible to answer them. The answers to such questions are necessarily involved and even based on different units of standard, hence the interpretation may sometimes be at fault. It is felt, however, that a good beginning has been made if no more is accomplished than to incite more thought on these subjects. Much disparity of opinion is revealed, not so much between authorities within a community as between large geographical divisions. Such differences may be based

on fundamental economic principles which largely justify the difference of practice, yet a comparison of ideas may assist all to criticize existing practices and, perhaps, modify their custom in some respect in view of what others are doing.

The greatest contrast geographically is that between the Gulf States and the Pacific Coast. In the former, the use of the spray rod, lower pressures and necessarily smaller disc apertures is in decided contrast with the choice on the Pacific Coast. There are a number of reasons for this contrast which can be easily seen. First, the high price and

TABLE 2. RATE OF DISCHARGE

No. of replies	Gallons per minute	Remarks
1	1	For each nozzle, 50 per cent more for guns. Citrus.
1	2	At 200 lbs. pressure, using rods
3	3–5	Gun and rod
2	3	For rods, six gallons for guns
2	4	Six gallons excessive
2	5	Rods
1	4–6	Rods, six to ten for guns
2	5–6	On peach, higher on apple
1	5–7	
2	6	Gun and rod
2	6–7	Ten gallons a waste
1	7	Nine gallons for higher pressures
2	8	Gun, rod with Y on citrus
1	8–9	
1	12	Citrus
1	12–15	Medium to large trees, using one gun only
1	15	Minimum for gun. Citrus
1	16–20	Gun. Citrus
1	18	On orange, ten gallons on lemon

scarcity of labor during and since the war have, in California and the Pacific Northwest, caused the fruit grower to adopt every labor saving device possible such as high capacity outfits and the spray gun. This tendency has been emphasized to the point of extravagance in many instances, particularly where expensive spray mixtures are in use. Cold stormy winters in the Northwest with comparatively short spraying seasons have also intensified this movement. Compare this with the tabulation in Table IV, where the records for the Gulf States show a strong leaning towards spray rods and low pressures. Cheaper labor, favorable climatic conditions and the type of fruit grown (peach, with foliage more tender than the apple) will explain this at least in part.

The pressure of 400 pounds or greater is confined largely to the orange districts of California. This tree has a very dense foliage with stiff blades and stems that are difficult to move enough so that both sides may be sprayed, hence the demand for a high pressure.

TABLE 3. SIZE OF DISC APERTURE[1]

No. of replies	Size in 64/ths of an inch	Remarks
1	2–3	Using a cluster of four nozzles
1	2–6	Rods at 200 lbs. pressure
1	3–4	Rods with two nozzles
4	4–6	Rod. Uneconomical with high capacity outfits except with Y
2	5	Rod. For soluble material
3	6	300 lbs. pressure, two spray guns, small trees, soluble material
3	6–7	Guns or rods on citrus
4	7	Insoluble material, guns
1	7–8	Citrus. Change aperture for different size trees and for tower
1	7–9	Guns. Volume more important than pressure on large trees
5	8	For large trees, high pressure, insoluble material, with 325 to 400 lbs. pressure, on oranges, for lime sulfur and Bordeaux
1	8–9	For 5 to 7 gallons a minute
1	11	

[1]Thirteen stated that the size of aperture varies with the type of spray desired and gave no definite statement.

An interesting side light on the apparent need for high pressure in citrus groves is a report from Florida giving 175 pounds as a satisfactory pressure with 225 to 250 pounds the limit. This is presumably with spray rods. In this connection, it would be well to add the observation

TABLE 4. DISTRIBUTION OF REPLIES

	Type of Apparatus		Pressure				Size of Aperture (64ths)			
	Rod	Gun	100–175	200–275	300–375	400	2–4	5–6	7–8	9+
Gulf States.....	4		1	4	2		1	1	1	
Atlantic Seaboard..	2	7	1	9	8		1	2	2	
Mississippi Valley..	6	8	2	10	4		2	1	1	1
Pacific Coast.....	6	13	1	6	8	7	3	8	13	1
Total.....	18	28	5	29	22	7	7	12	17	2

of one of our California field entomologists,—a man eminently well qualified to give a critical opinion. He stated that the best job of coverage on citrus trees he had ever seen was done with a hand pump, giving a pressure of about 60 pounds and using spray rods. Such work, of

course, implies a slower rate of coverage, but unless the spraying season is very short, slow, careful work might be more satisfactory than rapid work with higher pressures.

TABLE 5. DISCHARGE RATES OF SPRAY GUNS AND RODS AT VARIOUS PRESSURES AND SIZE OF DISC APERTURES[1]

Amount gals.	Pressure lbs.	Time Min.	Time Sec.	Size of Aperture	Remarks
				Spray Gun	
5	375	1	55	6/64	
5	375	1	31	7/64	Different makes of guns
5	375	1	41	7/64	Different makes of guns
5	375		51	8/64	
5	375		25	10/64	
				Spray Rod	
5	375	5	10	5/64	One nozzle open
5	375	4	20	5/64	Two nozzles open
				Spray Gun	
5	350	1	43	6/64	Low pressure increased the time 34 per cent
5	225	2	18	6/64	
5	325		31	10/64	Low pressure increased the time 22 per cent
5	225		38	10/64	
				Coverage Time for One Tree	
8	380	2	31	6/64	Gun
8	380	2	15	6/64	Gun
7.7	380	7	30	5/64	Rod
15	380	1	18	10/64	Gun
22	380	1	50	10/64	Gun

[1]Cost of extra labor in applying with rod, over that of gun, $5 per acre. Waste by the use of an aperture of 10/64, compared with one of 6/64, was 14 gallons per tree, which at 3 cents per gallon would be 42 cents per tree. The gain in labor-time, —25 seconds, was equivalent to ½ cent.

The application was made by a nozzle man of a commercial spraying concern, allowing him to use his own judgment as to when he had covered a tree. The time of his work was kept and gallonage fixed accordingly. The five lemon trees in the coverage experiments were as nearly the same size as could be gotten.

The reports on dormant spraying for deciduous trees favored 50 to 75 pounds lower pressure than for foliage, although a number stated that no difference is made between the two states of the tree.

The variations in "Rate of Discharge" and "Size of Disc Aperture" are more difficult to explain and would lead one to think that the range is unnecessarily large. It is true that a distinction must be made be-

tween the rod and the gun, but why should the disc aperture for the gun range from six to eleven sixty-fourths of an inch and the discharge rate, from six to twenty gallons a minute? Surely the latter amount is more than the average nozzle man will economically apply.

To illustrate, the data in Table V are offered as concrete evidence of the variation in the rate of discharge by a change in pressure, size of aperture, and from the rod to gun, as worked out by the author. These differences will not, of course, be constant with all spray rigs but are given as an example of what may happen. It would seem to be good practice to test the efficiency of every spray machine by a similar series of experiments, for even though a machine is mechanically perfect improper assemblage of the parts might cause a serious variation in the pressure and rate of discharge.

A study of the replies received seems to indicate considerable variation in opinion as to what constitutes correct standards for the various types of sprays, different varieties of trees and for the varying economic conditions prevailing throughout this country. In two or three instances, it was stated that these problems are being studied, presumably as a cooperative project between Agricultural Engineers and Horticulturists, Entomologists or Plant Pathologists. This is very desirable and it is hoped that studies of a broad enough nature will be made so that the results may apply to all types of spraying problems.

THE VALUE OF SPRAYS FOR BLACK SCALE CONTROL IN CALIFORNIA

By R. S. WOGLUM and J. R. LAFOLLETTE, *California Fruit Growers Exchange, Los Angeles, Cal.*

ABSTRACT

Fumigation with hydrocyanic acid gas was successful in black scale control everywhere in California up to about 1910. Increased resistance to cyanide gas has developed and so spread as to seriously affect pest control over a thickly planted citrus area more than 30 miles long. Three sprays have shown results superior to fumigation. These sprays also control the citrus red spider against which fumigation is ineffective. Thorough sprying is essential. While fumigation gives practically uniform scale kill in all parts of the tree, top results have not been entirely satisfactory with sprays. The use of towers has greatly improved top spraying. Spraying averages about two-thirds the cost of fumigating.

For many years fumigation has occupied the field of citrus scale control in California to the almost total exclusion of spraying. Very recently, however, poor fumigation results against the black scale (*Saissetia*

oleae) in certain districts has encouraged increased spraying. During 1924 upwards of 25,000 acres of citrus trees were sprayed with various spray materials. Oil sprays, either alone or in combination with sulfur mixtures, have been the most popular. The wide variation of results and consequent dissatisfaction with spraying, even as with fumigation, induced the California Fruit Growers Exchange to investigate this field, particularly to determine the value of all different sprays used commercially as compared with fumigation for the control of black scale, in those districts where the latter is very resistant to hydrocyanic acid gas.

During the 1½ years this investigation has been under way the writers have personally checked the insecticide treatment on approximately 10,000 acres (about 1 million trees), including the work of about 60 commercial operators carried on in upwards of 1000 different orchards. Our methods include rating of scale infestations before treatment, together with knowledge of application and materials used. The results from treatment are later checked both for scale control and effect on tree and fruit.

Of the various insecticides which have come under our observation 3 spray materials have been more effective than fumigation in controlling the resistant black scale. All 3 sprays are proprietary materials, having an oil base. Two of the oil sprays were combined with lime sulfur while the third was a straight oil emulsion of highly refined lubrication type.

One miscible oil-lime sulfur combination has averaged the most satisfactory scale kill although a straight miscible oil of low volatility while giving less consistent results as a whole, was effective where particular attention was given to strength and application. Oil sulfur combinations produced fruit burning during a period of hot weather when the temperature approached 100 degrees. Fruit burning on oranges was practically as severe on trees sprayed at moderate temperatures 2 days prior to the hottest day as during the highest temperature. Injury was apparent even on trees sprayed 3 or 4 days prior to the maximum temperature. It would appear that applications made on a hot day immediately followed by cool weather are less likely of severe results than application on a cool day of high humidity quickly followed by a protracted spell of very high temperatures.

Because of this injury factor it appears unsafe to use such sprays on citrus trees during summer and early autumn. By October fruit has so matured that sulfur burn is a less serious factor; in fact, for 3 years

there has been no important commercial injury in work done from October to January. Lemons are far less susceptible to injury than oranges and spraying at temperatures as high as 100 degrees has been done in the more arid districts with commercial safety.

The straight miscible oil of lubricating type was harmless to foliage even at the highest temperatures and at concentrations upwards to 10 per cent. Another type of injury, however, of considerable commercial importance developed. Lemons are picked green and colored in storage houses. Some houses found that fruit recently sprayed with this low volatile oil spray were slow to color and in some cases could not be properly colored regardless of duration of storage. Lime sulfur and oil combinations were used both with calcium caseinate and without. There was very little commercial injury in work done where spreader was used but very severe injury in much work where no spreader was present. It appears essential that spreader be used in this combination spray from the standpoint of injury as well as scale kill. One pound of calcium caseinate to the 100 gallons appeared to be the most satisfactory proportion; in smaller amounts there appeared to be increased injury.

Oil-lime sulfur mixtures applied during the autumn control the citrus red spider very effectively. Inspection of approximately 2000 acres five to eight months following the application failed to reveal spider in a single instance. However, the last of May, spider began to appear in several orchards sprayed the previous autumn, in some cases quite severe. The orchards sprayed with the lubricating type of oil also showed good spider control. Although less rapidly acting than the lime sulfur-oil mixtures, the heavy miscible oil remains for such a long time on the foliage that it discourages the hatching spiders from feeding freely and its range of effectiveness is greatly extended.

It is important that particular attention be given to the tops of sprayed trees. Spray towers had never been used in California prior to last year when the writers' investigations, showing that sprayed trees averaged approximately 7 times as much scale in the top as the bottom, resulted in the majority of operators adopting towers. This situation has led to a marked improvement in the spraying practice. The tops of trees are in far better condition this year than last. There is need of further improvement. Last year towers were, for the most part, low. Both rods with mist nozzles and guns were used in the towers. This situation was reflected in top results, especially on large trees. Areas in the extreme top often showed poor coverage on otherwise well sprayed

trees. The answer is towers of such height that the entire top can be effectively sprayed, and the use of spray guns with their driving power. A fine mist spray, while satisfactory for spider, is decidedly less valuable in commercial scale control than the gun.

The importance of top spraying is well illustrated in the case of the following citrus orchards. All spraying was done by careful experienced sprayers but entirely from the ground. Where tops were slighted the previous year as in A and B with the result of severe scale infestation they are of particular importance in the following year's treatment. In the care of orchard A (10 acres) given below, the tops show improvement as well as the bottoms but the tops were so severely infested to start with that they still are in bad shape although the bottoms are very clean. Observations of the past year show that in such cases the scale as it hatches in the top scatters down throughout the bottom of the tree resulting in heavy infestation throughout. This is well exemplified in the case of orchard B which was so clean in the bottoms in 1924 that 16 twigs were examined before a single scale was found. The tops were dirty, about 4 scale per twig. During the hatching period of 1924 following the spraying so much scale came down from the tops that there was an enormous increase in the bottoms. Fumigation ordinarily gives a more or less uniform scale kill throughout the tree. The 1925 fumigation was poor and in spite of it the scale increase at the bottom amounted to 6233 per cent over that of the previous year. Although tree tops deteriorated 103 per cent against 6233 for the bottoms they continued to be decidedly worse off than the bottoms.

TABLE SHOWING THE IMPORTANCE OF TOP SPRAYING OF CITRUS TREES

Orchard	Part of tree	1924 Treatment	1924 Rating	1925 Treatment	1925 Rating	Improvement or Deterioration	Scale Ratio top to bottom
A	Top	1 spray	7.64	1 spray	4.66	+39%	10 to 1
	Bottom		1.28		.46	+64%	
B	Top	2 sprays	3.94	Fumigation	8.00	—103%	
	Bottom		.06		3.80	—6233%	2 to 1

A NATURAL BREEDING AREA OF THE BEET LEAFHOPPER (*EUTETTIX TENELLA* BAKER) IN THE SIERRA NEVADA MOUNTAINS

By HENRY H. P. SEVERIN, Ph.D., *California Agricultural Experiment Station.*

ABSTRACT

The beet leafhopper (*Eutettix tenella* Baker) has been found in four valleys situated in the Sierra Nevada Mountains. A natural breeding ground occurs in Honey Lake Valley at an altitude of about 4000 feet. The leafhoppers were found breeding in Red Stem Filaree (*Erodium cicutarium*) growing in a sagebrush area on the foothills. Early planting with reference to the spring and autumn dispersal of this insect is of no practical value in these valleys. There is no evidence to show that the adults migrate from the mountain valleys into the Sacramento Valley.

INTRODUCTION

The beet leafhopper and curly leaf (curly top or blight) of sugar and stock beets were reported to be present by previous investigators in the valleys of the Sierra Nevada Mountains. Mr. W. J. Hartung made a trip to these mountain valleys during April, 1919, and test plots of sugar beets were planted in different valleys. These plantings were visited again by Mr. Hartung on June 10th to 18th, and he reported as follows:

Sierra Valley (altitude 5000 feet). The beet leafhoppers were abundant in the northwestern portion of the valley but no curly leaf was present in the beet fields.

Honey Lake Valley (altitude 4000 feet). No beet leafhoppers and curly leaf were found in the beet fields in the vicinity of Standish.

Indian Valley (altitude 3600 feet). The beet leafhoppers and curly leaf were found at Taylorsville while stock beets were badly blighted.

American Valley (altitude 3400 feet). The beet leafhoppers were abundant and large numbers of sugar and stock beets showing curly leaf symptoms were found.

Genesee Valley (altitude 3688 feet). No *Eutettix tenella* and no diseased beets were found.

Mr. E. A. Schwing, Entomologist of the Spreckels Sugar Company, visited the Sierra and Honey Lake Valleys on June 29th and October 8th, 1924, and found the beet leafhoppers on Russian Thistle (*Salsola kali tenuifolia*) and Red Orache or Redscale (*Atriplex rosea*).

SIERRA VALLEY

Mr. E. A. Schwing and the writer visited the Sierra and Honey Lake Valleys on May 5th to 7th, 1925. The dark overwintering adults were

taken on Red Orache or Redscale in the eastern mouth of the Sierra Valley. The females were extremely scarce, most of them probably died owing to the fact that they were at the end of their natural life. The pronotum of some of the adults was yellowish green with dark markings on the wing covers, but typical overwintering forms were also taken with the yellowish pronotum. The elytrae of some of the specimens were worn and the dark markings faded, indicating the approach of old age.

Honey Lake Valley

The foothills three miles southwest of Standish were examined and nymphs in all stages of development were found on short Red Stem Filaree growing sparingly on the rocky hillsides. Pale green spring brood adults without markings on the wing covers were taken. An adult which had recently acquired the winged stage was also taken.

The foothills one mile northeast of Litchfield were examined and nymphs were extremely scarce. The pale green spring brood adults were not abundant, the largest number taken by sweeping Red Stem Filaree with an insect net was two specimens.

Sagebrush Country

Shaw (2), in a discussion of the natural and artificial barriers to leafhopper invasion, observed that "land immediately contiguous to a wide stretch of sagebrush country is likely to be invaded any season when the hoppers are abundant." Ball (1) disagrees with Shaw and states, "In all the writer's observation they have, however, never been found on sagebrush or in a sagebrush area." In the Sierra and Honey Lake Valleys the hills and valleys not cultivated are covered with sagebrush (*Artemisia tridentata*), but it was on Red Stem Filaree growing on the rocky slopes below the sagebrush that the beet leafhopper was found.

Natural Breeding Area

The presence of the pale green spring brood adults in any locality is no indication of a natural breeding area of the beet leafhopper, for it is a well known fact that this insect migrates long distances. The presence of the dark overwintering adults in any locality during the autumn and winter is no indication of a natural breeding area, for it is a well known fact that where insects migrate from their natural breeding grounds they fail to establish themselves in their new environment unless they meet conditions identical with their original habitat. The fact that nymphs in all stages of development, as well as the pale green

spring brood and dark overwintering forms were found on the foothills near Standish, places this section of the Honey Lake Valley into a natural breeding area. A dry belt extends from the Sierra Valley, Honey Lake Valley, Madeline Plains northward and probably the drier portions of the entire region are a natural breeding ground.

PRECIPITATION. The precipitation at Litchfield is 11.5 inches, of which amount "⅔rds possibly ¾ths is melted snow." The precipitation increases in the form of snow with the elevation. The rainfall is favorable for the multiplication of the beet leafhopper on the foothills.

HIBERNATION. The autumn rains germinate the seeds of Red Stem Filaree and this plant remains below the snow in the form of a rosette. In all probability, the dark overwintering females hibernate among these plants during the winter.

EARLY PLANTING AND YIELD

According to one beet grower near Litchfield, beets should be planted from April 1st to 20th, in the Honey Lake Valley and should not be delayed until May 1st. I was informed, however, that frosts are of common occurrence during April. One grower near Standish harvested 800 tons of beets from 36 acres during 1914, but in 1919, his yield averaged six tons per acre which failure he attributed to labor troubles. The following information was obtained from the Secretary of the Lassen County Chamber of Commerce at Susanville as to the average yield of beets per acre:

Standish 12–15 tons per acre in 1919
Litchfield 11.5 tons per acre in 1919

SPRING FLIGHTS

No spring flights into the cultivated areas had occurred in the vicinity of Standish and Litchfield up to the end of our visit on May 7th. The spring brood will probably invade the cultivated regions between May 15th and 30th. Early planting would, therefore, be of no practical importance if the spring flights occur during the latter part of May every year.

MIGRATION FROM VALLEYS IN SIERRA NEVADA MOUNTAINS TO SACRAMENTO VALLEY

It has been suggested that the beet leafhopper may migrate from the valleys in the Sierra Nevada Mountains to the Sacramento Valley owing to the fact that the spring brood usually invades the Sacramento Val-

ley later than the northern portion of the San Joaquin Valley. There was no evidence, however, of a spring flight from the foothills into the cultivated areas of the Honey Lake Valley, while in the Sacramento Valley migratory flights had occurred as early as April 29th, in the Sutter Basin and Marysville districts, according to Mr. Schwing's observations. If winds are a factor with reference to the migration of this insect, the prevailing southwest wind in Honey Lake Valley would tend to carry the leafhoppers into northwestern Nevada.

Practical Considerations

Early planting with reference to the spring and autumn dispersal of the beet leafhoppers is of no practical value in these mountain valleys. An intensive survey extending through periods of normal precipitation as compared with dry years should be made of the foothills bounding these valleys to determine the relative abundance of beet leafhoppers. Honey Lake has been dry for a period of five years, whereas previously this lake was dry one year in a ten-year interval. Test plots should be planted and the percentage of curly leaf should be determined during each season. In 1914 and 1919, from 11.5 to over 20 tons of beets were harvested in Honey Lake Valley when a general outbreak of the pest occurred throughout California. Mr. Hartung's visit to the mountain valleys on June 10th to 18th, 1919 was entirely too early to determine the curly leaf situation.

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PERCENTAGE OF CURLY LEAF INFECTION IN BEET LEAFHOPPER (*EUTETTIX TENELLA* BAKER) AND WINTER HOST PLANTS UNDER FIELD CONDITIONS

By Henry H. P. Severin, Ph.D., *California Agricultural Experiment Station.*

Abstract

The percentage of curly leaf (curly top or blight) which develops in beet fields after the spring dispersal of the beet leafhopper (*Eutettix tenella* Baker) from the plains and foothills depends upon the number of leafhoppers on each beet. Seventeen per cent of the spring brood adults collected on the foothills of Little Panoche Valley in the San Joaquin Valley transmitted curly leaf to sugar beets. One per cent of the winter host plants, namely Red Stem Filaree (*Erodium cicutarium*) harbored curly leaf under natural conditions on the foothills of Little Panoche Valley.

Curly Leaf Infection after Spring Flights

When the pale green spring brood beet leafhoppers fly into the beet fields in a natural breeding area, such as the San Joaquin Valley, some of them are infective and the percentage of curly leaf which develops depends upon the number of hoppers on each beet. During the 1919 outbreak of curly leaf, at least ten adults were present on each beet in the late plantings at Connor, situated near the Tehachapi Mountains in the southern part of the San Joaquin Valley. The first spring flight of the leafhoppers occurred on April 8; on April 17, 40 per cent of the beets showed curly leaf symptoms; and on May 7, 96 per cent were blighted in one field.

During 1920 there was a marked reduction in the number of spring brood leafhoppers which flew into the beet fields in the lower San Joaquin Valley and a low percentage of curly leaf was present until the second brood adults appeared. The spring brood adults began to invade the beet fields on April 23. Two fields were selected; one planted in March had an average of one leafhopper to a beet and an April planting had one adult to six or seven beets. The beets in both fields were so badly blighted that they were not harvested. The percentage of curly leaf was determined twice per month and increased as follows:

Beets planted late in March—May 1, 6%; May 14, 16%; June 1, 60%; June 16, 92%; July 1, 100%.

Beets planted in April—May 1, 0; May 14, 2%; May 28, 8%; June 16, 30%; July 1, 94%.

The percentage of curly leaf which developed in the beet fields during a number of seasons after the spring migration of the adults into the Sacramento Valley has already been published (4).

Percentage of Infective Spring Brood Beet Leafhoppers

During 1924 an experiment was conducted to determine the percentage of infective spring brood beet leafhoppers collected on April 8, on the foothills bounding Little Panoche Valley situated in the middle San Joaquin Valley. The pale green adults were collected on Red Stem Filaree and White Stem Filaree (*E. moschatum*). Red Stem Filaree harbors curly leaf under natural conditions and White Stem Filaree is susceptible to the disease under greenhouse tests, hence these plants were not used as food material for the insects in captivity. The leafhoppers were provided with the foliage from large healthy beets, and at the end of every three hours, a fresh supply of leaves was put into the cage. During the night the leaves were removed from the cage and the

bugs were without food. In two previous papers the writer (2, 5) published the fact that the minimum incubation period of the causative agent of curly leaf in beets with from 4 to 6 leaves including the cotyledons was two days and from 12 to 16 leaves, five days, hence there was no opportunity for the leafhoppers to become infective when provided with the foliage from healthy beets at the end of every three hours.

In the greenhouse 50 males and 50 females were confined singly in cages, each enclosing a healthy beet seedling. At the end of two weeks each leafhopper was provided with a second healthy beet except those hoppers which had transmitted curly leaf to the first healthy plant. At the end of four weeks each bug received a third healthy beet and so on for a period of 16 weeks. The experiment was begun on April 10, and discontinued on August 1.

Nine males and eight females, or 17 per cent transmitted curly leaf to sugar beets. Eight males and seven females caused the disease to develop in the first beet. One male infected the third beet and not the first and second plant, or a period of at least 28 days elapsed before the insect transmitted the disease. One female infected the second beet but not the first plant, a period of at least 14 days in which no infection occurred.

In a previous paper (5) attention was called to the fact that when infective leafhoppers were provided with a healthy beet daily during their entire adult life there were intervals of from 8 to 56 days between the infection of two successive beets.

Percentage of Curly Leaf Infected Winter Host Plants

Red and White Stem Filaree plants were collected at random in Little Panoche Valley. Short Filaree curls during April and it is impossible to determine with certainty which plants are infected with curly leaf. Large numbers of beet leafhoppers had congregated on both species of Filaree growing in depressions of squirrel mounds, and it was here that many plants were removed with the root system. The Filaree was planted in pots in the greenhouse.

To determine whether Filaree harbors curly leaf under natural conditions, 10 non-infective male beet leafhoppers were allowed to feed on each plant for a period of five days and then they were transferred to a healthy beet. Fifty Red Stem Filaree and 50 White Stem Filaree plants were tested in this manner. One beet developed a typical case of curly leaf and 99 beets remained healthy. It is evident, therefore, that only

1 per cent of the Filaree plants harbored curly leaf under natural conditions.

Factors Associated with Low Percentage of Curly Leaf Infection in Beet Leafhoppers

After the return flights of the dark overwintering adults to the plains and foothills during a dry autumn, large numbers of leafhoppers congregate on perennials and if these plants are not susceptible to curly leaf, then the percentage of infective adults would not increase. Enormous numbers of these insects are frequently found on large perennial saltbushes in the San Joaquin Valley, such as Spinescale (*Atriplex spinifera*) and Allscale or Cattle Spinach (*A. polycarpa*) which are not susceptible to curly leaf. Ballscale (*A. fruticulosa*), a small spreading perennial saltbush from 2 to 12 inches high, often grazed down by cattle and sheep to a mat-like form, is commonly found on the plains and foothills in the San Joaquin Valley and harbors curly leaf under natural conditions. A small shrub (*Isocoma veneta*) serves as a food plant on the plains and foothills during a dry autumn and is susceptible to curly leaf under greenhouse tests, but has not been found to harbor the disease under natural conditions.

Incomplete hibernation (1) in which the dark overwintering adults may live about a month without food during the winter, prevents the spread of the disease to host plants on the plains and foothills and reduces the possibility of infection of the spring brood.

Another factor which may prevent the rapid spread of the disease in Red Stem Filaree during the winter, and hence reduce the possibility of infection of the leafhoppers, is the longer incubation period of the infective principle of curly leaf in the plant. The minimum incubation period during the spring and summer in sugar beets with 4 to 6 leaves including the two cotyledons was two days; 12 to 16 leaves, 5 days; in beets about three months old and in stechlings required 15 days during the winter (2, 5) in the greenhouse.

When the beet leafhopper is provided with a healthy beet daily, the insect transmits curly leaf to fewer beets toward the end of its natural life (5). If this occurs under natural conditions infective dark overwintering females would transmit curly leaf to fewer Filaree plants during February and March, hence reducing the opportunities for the spring brood nymphs to become infective.

It is evident that the factors associated with a low percentage of curly leaf infection in the spring brood beet leafhoppers is intimately connected with the curly leaf infection of the dark overwintering adults

and the food plants on the plains and foothills. Red and White Stem Filaree when infected with curly leaf in greenhouse experiments show a marked curling of the inner leaves, the outer leaves turn yellow and the plant dies. Small Filaree plants succumb much more rapidly from the disease than do the older plants. If this occurs under natural conditions then the Filaree infected in October and November after the return flights of the dark overwintering adults to the plains and foothills would die before egg deposition begins. Eggs deposited from February 24 to March 31, 1919 required from 35 to 55 days to hatch in the northern part of the San Joaquin Valley (3). If Filaree was infected with curly leaf by the dark overwintering females at the time of oviposition, it may be possible that the plant would die before the eggs hatched during the long egg period. Curly leaf would then be weeding out the diseased plants on the foothills; if the plant dies, the egg fails to hatch, thus diminishing the number of infective spring brood hoppers.

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SOME EFFECTS OF *TRIBOLIUM* ON FLOUR

By Nellie M. Payne, *University of Minnesota*

Abstract

Tribolium infestation affects the elasticity and the viscosity of flour. Heavy infestation turns flour a pinkish tinge which becomes brown upon oxidation. Adults give off a characteristic secretion soluble in water. This secretion may be the cause of the marked effect which *Tribolium* has on the physical properties of flour colloids.

Introduction

The problem of testing the effect of *Tribolium confusum* Duval on flour was brought to the attention of the writer in connection with a

course in biochemistry. Flour colloids were used for some of the characteristic physical tests of colloid behavior. Thanks are due to the division of Biochemistry and to Dr. Bailey especially for aid and suggestions in this study.

The effect of *Tribolium* on flour was attacked from the standpoint of measureable physical differences between an infested flour and its control. Since no baking tests were performed these experiments are to be regarded as preliminary, but at least as a partial answer to the question "What effect has infestation on food products?" The changes here measured have to do with physical measurements of flour strength. Gortner and Sharpe (1923) have discussed the relation between viscosity and flour "strength." The MacMichael viscosimeter was used in this problem to determine viscosity and indirectly flour "strength." This instrument is essentially a machine for measurement of torsion in liquids. A liquid of known concentration is placed in a cup. A disc is then rotated in this cup. The disc is attached to a fine wire mounted on a stand. The twist given this wire is measured in degrees of rotation. Calibration is accomplished by first determining the viscosity of known concentrations of sugar. A diagram of the viscosimeter is shown.

A second measure of flour "strength" was used during the period when the Chopin Extensimeter was loaned to the laboratory. The principle of this machine is simple. A bubble with a thin surface was made from a cylinder of dough. The measure of the tenacity of the dough was estimated by the effort necessary to force this dough to take a definite form. The pressure measured in millimeters of water recorded on the manometer was used as a measure of tenacity. The dough was made up in the same manner for each test and held at a constant temperature. Bailey and Le Vesconte (1924) discuss the Extensimeter method of measuring flour strength. A less technical discussion than that by Gortner and Sharpe (1923) is by Sharpe and Gortner (1923) in Minnesota Technical bulletin 19.

Economic Entomological Literature

Tribolium confusum is an important stored products pest which has been introduced from Europe. It has figured largely in our Entomological problems since 1893. Chapman (1917) states with regard to its importance:

"Perhaps the most widely distributed insect attacking flours and other cereals in Minnesota is the confused flour beetle, *Tribolium confusum* Duval. . . . This beetle does not claim the attention of the

millers as much as does the Mediterranean flour moth which spins silk and clogs the machinery, but it is nevertheless a pest which causes much loss."

Chittenden (1896) reports *Tribolium* as feeding upon flour and other cereals. Dean (1909) gives an extensive list of products infested. Girault (1912) states that the adults do more damage than the larvae.

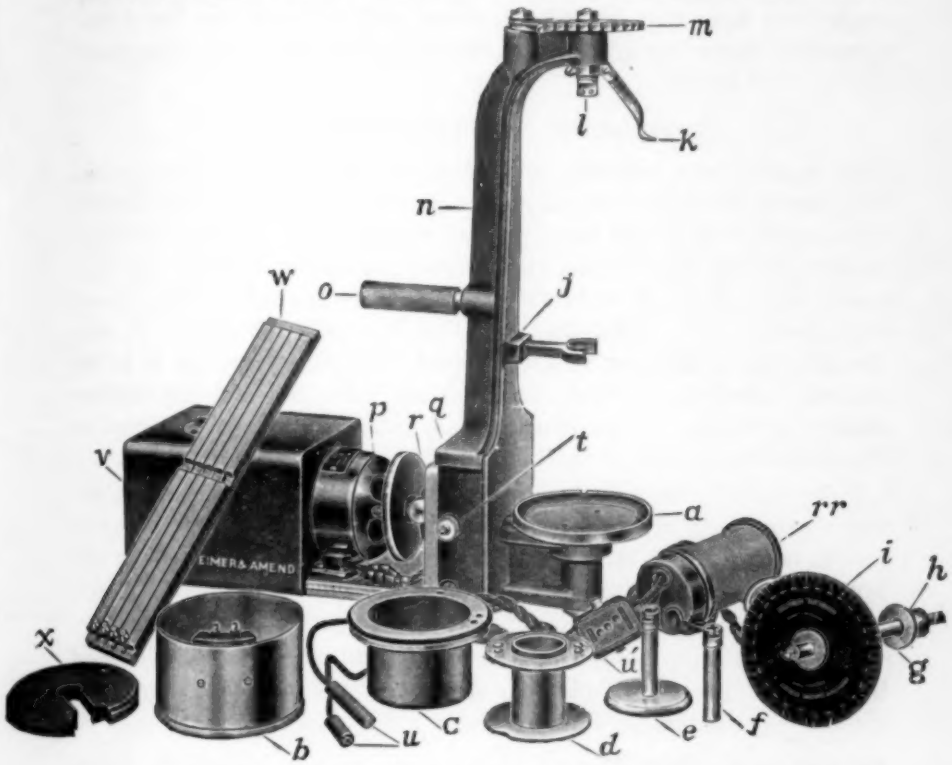

FIG. 19.—MacMichael Viscosimeter; *a*—Turntable, *b*—Outer cup, *c*—Inner cup, *d*—Standard diameter cup, *e*—Disk bob, *f*—Cylindrical bob, *g*—Hollow spindle, *h*—Dashpot, *i*—Disk, *j*—Supporting arm for disk, *k*—Adjustable pointer, *l*—Attachment pins, *m*—Notched disk, *n*—Upright support, *o*—Handle, *p*—Electric motor, *q*—Adjustable set of gears, *r*—Friction governor, *t*—Switch for starting motor, *u*—Pin connections, *u'*—Switch, *v*—Sliding metallic cover, *w*—Wooden block for holding wires not in use, *x*—Cap cover.

This observation is corroborated by the experimental results of the present writer.

One of the chief characteristics of *Tribolium* adults has been apparently overlooked by many of the workers in economic entomology.

The giving off of a pungent odor when disturbed has however been mentioned by Chapman (1921) in the following words: "When rubbed between the fingers they give off a rather sharp pungent odor which irritates the membranes of the nose." Doane (1918) makes the following statement in regard to the effect of *Tribolium navale* Fab.: "Their presence gives the food a disagreeable, musty odor. Bread made from flour that has been infested with these beetles has a disagreeable odor when first baked, but this all or nearly all, disappears as the bread cools."

Experimental Results and Methods

In rearing large numbers of *Tribolium confusum* for experimental purposes it was found that the flour used for feeding became colored with a pinkish tinge and had a distinct pungent odor. Such flour when tested with the MacMichael viscosimeter gave an exceedingly low viscosity when compared with normal flour. (See figure 19 for diagram of viscosimeter. The elasticity was also markedly affected. It was thought that airing out of the infested flour might restore it to its original "strength." Airing lessened the odor but did not restore either the viscosity or the elasticity. A pinkish flour when exposed to the air became a light brown but did not regain its white color.

Fully realizing that flour carried to the discolored state was an extreme case, some experiments were made with infested flour that appeared normal. For three weeks one hundred adults were fed on one liter of flour, and then tested against a check from the same sack which was uninfested. The same experiment was performed with larvae.

The flour infested with adults was more affected than that infested by larvae. This calls to mind the statement of Girault (1912) concerning the relative damage done by adults and by larvae.

Viscosity of Flours in Degrees MacMichael Plotted Against cc. Lactic Acid Added to Test Flour Solutions

cc. Lactic Acid	Check flour	Pink	Adult infested	Larval infested
0.	3	1	2	3
.2	6	2	4	6
.4	15	4	12	14
.6	37	5	20	33
.8	57	6	38	52
1.	15	5	8	12
1.5	11	4	6	9

When an acid is added to a hydrophilic colloid the water adsorption is increased to a maximum and this maximum is followed by a sudden

decrease when more acid is added. This effect appears to be due in part to the PH change and in part to the nature of the anions added. Lactic acid one-tenth normal was used throughout this set of viscosity experiments. A graph with viscosity plotted in degrees MacMichael against cc. of lactic acid added shows the relations between the viscosity changes in normal, and in infested flour (See figure 20).

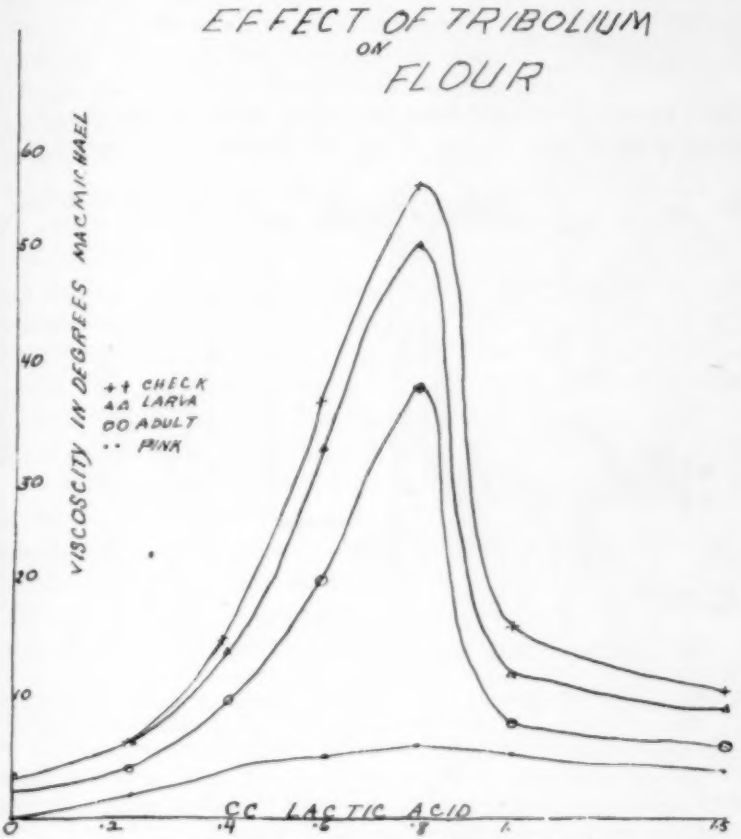

FIG. 20.—Graph showing effect of Tribolium on flour.

The elasticity changes in infested flour were marked. From a pink flour it was almost impossible to make a standard dough, on account of its low water adsorption. The bubble formed was so small that it was impossible to get an accurate reading of the force. The dough resembled paste. Normal flour and moderately infested flour were used and readings were obtained. A piece of standard dough was clamped

between the plates A and D in the figure (See Fig. 21) and air let in under the dough through the air chamber C in the figure. The dough rose to a maximum after which the bubble burst. Readings were taken at the maximum.

EXTENSIBILITY OF NORMAL AND INFESTED FLOURS MEASURED AS MILLIMETERS OF WATER PRESSURE REQUIRED TO BURST DOUGH BUBBLE

Flour infested with adults	13.9
Flour infested with larvae	14.8
Normal, uninfested flour	17.6

Since the larval infested flour was not so greatly changed as the adult infested flour it was thought that the characteristic secretion of the

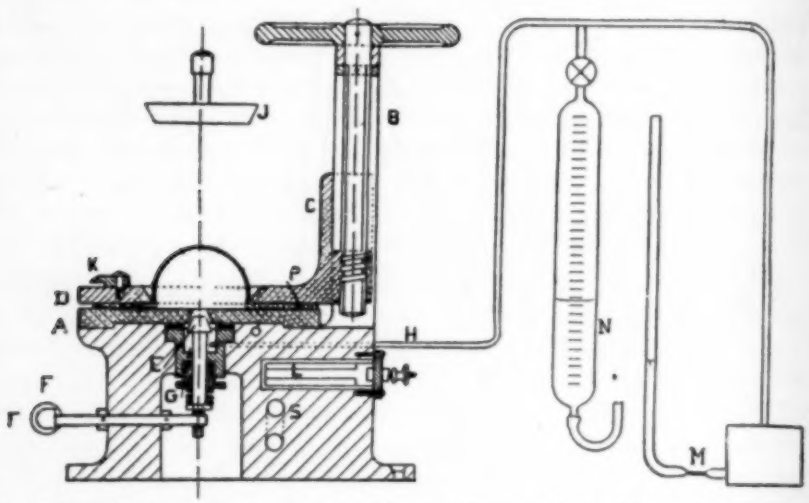

FIG. 21.—Chopin Extensimeter; *A*—Circular Bronze plate with conical opening, *B*—Vertical column, *C*—Movable bronze standard, *D*—Bronze plate, *E*—Valve for closing opening in Plate A, *F*—Lever, *G*—Air chamber, *H*—Tube, *J*—Lid, *K*—Swivels to hold lid, *L*—Electrical resistance to heat, *M*—Water manometer *N*—Glass measure graduated in cc., connected by rubber tubing to working flask containing water, *P*—Movable metal disk, *S*—Switch.

adults might be responsible for the breaking of the viscosity and elasticity in infested flour. An attempt was made to isolate this substance and to test the effect on flour of the secretion alone.

In order to isolate the secretion a large quantity of beetles were collected by running several sacks of infested flour and odd lots of flour that had accumulated in store rooms were run over a shaker and the beetles thus separated from the flour. A pint of beetles was collected

and placed in a round bottomed flask. The flask was fitted with a tube hole stopper in which were placed one L tube connected to an air blower by means of rubber tubing; and a U tube with one opening in the flask containing the beetles and the other immersed in distilled water. The ends of the tubes were covered with gauze to prevent beetles from entering. Care was taken to make the connections air tight. The air current was started. The secretion was driven off into the water and dissolved to make a red solution. By running the air current at intervals the maximum gas production was obtained, since the beetles do not give off their secretion continuously, even when disturbed.

The solution obtained was used with further flour experiments. Not enough material was obtained to run a viscosity test. The elasticity was slightly less than normal dough made with distilled water, and the water adsorption of the dough made with the secretion solution was less than normal.

A portion of water containing the dissolved secretion was reserved for chemical tests. The solution formed a well marked ring characteristic of the aldehydes when the Acree-Rosenheim reagents were added to it. Atmospheric oxygen changed the solution to a light brown after several days standing. Hydrogen peroxide did not entirely decolorize it, but bromine water did. Neither sulfuric acid, hydrochloric acid, nor sodium hydroxide produced color changes or apparent reaction in the solution.

More gas was collected and the elasticity and water adsorption of the dough measured as before with substantially the same results. Fifty cc. of the solution were placed in a weighed evaporating dish and cautiously heated. The secretion was not driven off. After evaporating to dryness there remained a weighable residue which was soluble in sodium hydroxide and charred on the addition of sulfuric acid. The residue obtained from fifty cc. of solution was 1.1 milligram.

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COATED ARSENATE OF LEAD[1]

By E. R. VAN LEEUWEN, *Asisstant Entomologist*, and P. A. VAN DER MEULEN, *Agent, Bureau of Entomology, United States Department of Agriculture.*

ABSTRACT

This paper deals with the coating of lead arsenate with a metallic soap and its use against the Japanese beetle (*Popilla japonica* Newm.). When lead oleate is precipitated under proper conditions it forms an intimate mixture consisting of globules of lead oleate with uncoated particles of arsenate of lead. After drying, the lead oleate spreads upon the surface of the arsenate of lead powder and upon the leaf and produces a coated material which adheres very firmly to the leaf surface.

From experiments made by several investigators, covering a period of some years, it has been shown that Japanese beetles (*Popillia japonica* Newm.) are to a large extent repelled from foliage sprayed with arsenicals. Why this is the case when the arsenicals are high in toxicity is not clearly understood. The fact remains that only a few of the beetles will eat a killing dose of acid arsenate of lead on foliage. As it was believed that the toxicity of the arsenical was responsible for the low percentage of kill obtained, search was undertaken for a method of treating this poison so that the action of the digestive juices of the insect upon the poison would be delayed. Success has attended this work, and the results obtained indicate that coated arsenate of lead is a more effective killing agent than the ordinary arsenate. Additional data, however, bring out the fact that the reason is not due alone to the masking of

[1]Contribution No. 3, United States Department of Agriculture, Japanese Beetle Laboratory, Riverton, N. J.

toxicity. Other factors, such as odor, taste, color, and physical constitution resulting from the coating, may play an equal if not a more important part in the results obtained through the coating process. The purpose of this paper is to report the results of investigations on the coating of lead arsenate with an insoluble metallic soap, and the results attending the use of the coated arsenate in laboratory and field experiments.

The Chemical Phase of the Coating Process

The problem essentially was to devise a method of coating so that the resulting product could be used in the form of a spray; and various soaps were tested as possible coating materials.[2] Among these were the oleates, stearates, linoleates, and ricinoleates of lead, zinc and aluminum; and the zinc, aluminum and lead soaps from cottonseed and menhaden oils. From the results of these experiments[3] a process for making the coated material in a commercial way was formulated. A patent was applied for but it was found that the process had already been invented by A. S. Ramage and covered by a patent (U. S. Patent No. 1,161,387) assigned to the International Color and Chemical Company, of Detroit.

The process, as finally developed, consists in bringing about a suspension of lead in water, by any of the usual precipitation reactions. To this suspension a calculated amount of sodium oleate, dissolved in water, is added. While this mixture is vigorously agitated a solution containing a quantity of lead acetate chemically equivalent to the sodium oleate is introduced. This produces lead oleate in the form of minute globules, intimately mixed with the arsenate of lead, but the lead oleate is prevented from spreading on the particles of the arsenate by the film of water surrounding them. When the preparation dries, however, this spreading takes place, and a coated, water-repelling powder results.

It is important to note that a lead arsenate which has been dried is apparently unsuitable as a starting material for making this preparation. The drying produces a certain amount of agglomeration, resulting in small porous lumps. Our experiments indicate that when the lead oleate

[2]Some work was accomplished along this line by Dr. William Moore in coating lead arsenate with lead stearate, zinc stearate and lard, by grinding the materials in a mortar for a period of three hours. This work was reported by Dr. Moore in the Journal of Economic Entomology, vol. 16, No. 1, pp. 67–71, Feb., 1922. In actual practice the writers found this method tedious and slow.

[3]The writers express their acknowledgments for the work done by Mr. L. L. Goolden, formerly connected with the Japanese Beetle Laboratory, in developing the commercial production of the spray mixture.

dries in contact with these lumps the result is wholly unsatisfactory from a coating standpoint. It is necessary, therefore, to handle the material in paste form throughout.

To ascertain the minimum quantity of lead oleate necessary for coating, and also to show that the coating is uniform, the following experiment was carried out. A weighed amount of commercial arsenate of lead powder ($PbHAO_4$) was mixed with benzene containing a known quantity of lead oleate in solution. The benzene was allowed to evaporate at room temperature, and a small quantity of the dried powder was shaken with water. Since lead oleate is not wetted by water, the powder which is coated floats on the water, whereas the uncoated sinks readily. This simple test gives a fairly sharp indication as to whether we have a coated powder, or a powder which has a considerable exposed surface of arsenate of lead. It was found that lead arsenate with less than 0.1 per cent by weight of lead oleate is easily wetted, one containing 0.15 per cent is partially wetted, and 0.25 per cent gives a slightly wetted powder; larger amounts give powders which are practically not wetted, even when shaken for a minute or more.

The lead arsenate used in the foregoing experiment consisted of particles with a diameter of 1.2 microns. By continued rubbing with water larger aggregates were broken up to particles of approximately this size. If we assume for the purpose of calculation that the particles are spheres, we find that the area of the grains in 1 gram of powder is 8,300 square centimeters. The area covered by a molecule of oleic acid when spread as a film on water has been shown by Adam[4] to be 23×10^{-16} square centimeters. The area covered by a molecule of lead oleate, $Pb(C_{18}H_{33}O_2)_2$, will be roughly double this value provided the orientation is similar in the two cases. A simple calculation shows that 0.0024 gram of lead oleate, or 0.24 per cent, should form a monomolecular layer over the surface exposed by one gram of the arsenate of lead powder. The agreement between the calculated and the experimentally determined value is much closer than one can reasonably expect with the present materials, and is probably a coincidence. The result shows, however, that the lead oleate must be very uniformly distributed over the surface, and even when the film is of molecular thickness the powder is not readily wetted by water. The proportion of lead oleate here determined, 0.24 per cent by weight of the arsenate of lead, is to be regarded as a minimum. In actual practice more lead oleate than this would be used.

[4]Proc. Roy. Soc. A. 99, 336; 101, 452.

Tests of the Material as an Insecticide in Cages

In view of the well known habits of the Japanese beetle it was necessary to carry on feeding tests in cages in order that the beetles might be held under observation. The method of procedure with the insecticide here considered was as follows: Fifty beetles were placed in each cage and experiments were made in duplicate, thereby comparing the results of feeding the beetles on foliage sprayed with coated lead arsenate and with uncoated commercial lead arsenate. Two types of checks were provided, those with unsprayed foliage and those with no food whatever. Comparing the results taken at the end of a 48-hour period, the kill was as follows under the respective conditions:

	Percentage of Beetles Dead			
Date	Lead arsenate	Coated lead arsenate	Starvation	Check
June 28	34	80	18	4
July 3	39	56	36	4
July 9	54	86	24	4
July 13	27	79	26	4
July 23	9	19	4	2
Aug. 6	47	65	26	9
Aug. 13	43	41	41	26
Aug. 20	37	83	48	10

During the tests experimentation was steadily continued in order to improve the coating of the lead arsenate. In some cases the coating was not complete, but the comparatively large amount of sprayed foliage eaten and the shorter time of kill were the outstanding factors in favor of the arsenical coated with lead oleate.

Tests of the Material as an Insecticide in the Field

The material was used extensively at various strengths in the field. A comparison of the spreading and sticking ability of this coated arsenate of lead was also made with various materials added to lead arsenate to increase the efficiency of the arsenical.[5] The following materials were used in these tests: 2% lead oleate, 5% lead oleate, 10% lead oleate, flour, dried skim milk, hydrated lime, combinations of skim milk and lime, gum Arabic, fish oil, and calcium casinate. The method employed in testing the value of the above materials is briefly as follows: Suspensions or solutions of each of the materials used were prepared on the basis of the presence of equal amounts of arsenic oxide per 100 gallons of water. Unsprayed orchards were divided into plots of four trees

[5]This work was done by Mr. F. Metzger, Junior Entomologist, Bureau of Entomology, United States Department of Agriculture.

each and the trees given a very thorough application of the spray to be tested, using a power sprayer at a pressure varying from 175 to 200 pounds. When a block had been sprayed the tank was emptied, rinsed and refilled. Immediately after the foliage was dry, and at intervals of 7 days for a period of 4 to 6 weeks, leaf samples, cut with a leaf punch having a diameter of 1¼ inches, were taken from the various plots for analysis of arsenic. Uniform leaf areas were thus obtained, and each sample was allowed to drop into a wide-mouthed bottle, no arsenic being brushed off by handling. Each sample contained 225.50 square inches of leaf area. Preliminary to determining the arsenic[6] the organic matter was oxidized by means of sulphuric and nitric acids in the bottle in which the sample was originally collected, thereby preventing any loss of arsenic. In all, seven experiments were run. With one exception, a close second, the samples taken from the trees sprayed with the coated lead arsenate contained the most arsenic. The plants experimented upon were apple, cherry, grape, small shrubbery, and certain forest trees. The results showed that when the coated material was used at the rate of four pounds in the form of a paste to fifty gallons of water the foliage was uninjured, and that from 80 to 100 per cent control was obtained. The method of determining the percentage of kill from the use of the various sprays employed in the field against the beetle has not been altogether satisfactory because of the activity of the insect, but where coated lead arsenate was used many dead beetles were found. The protection during the 6 to 8 weeks of the beetle period was definite with the one application whenever the spraying had been timely and thorough.

As the beetles do the greatest damage during a period of 6 to 8 weeks, repeated applications of the ordinary arsenate of lead are necessary; this treatment frequently results in severe burning. The coating of the material has therefore not only given a higher percentage of kill of beetles, but has increased its spreading and sticking qualities far beyond those of any other material in use at the present time. The material, used at the rate of 4 to 6 pounds of the paste to 50 gallons of water and thoroughly applied, will leave very little of leaf surface unprotected and will give a higher percentage of kill of the adult Japanese beetles than any other poison that has thus far been used.

Summary

A method has been perfected of coating arsenate of lead with an insoluble soap. The cage tests with this material have shown a higher

[6]Arsenic analyses were made in 1923 by L. L. Goolden, and in 1924 by W. A. Wilson, formerly employed at the Japanese Beetle Laboratory.

percentage of kill. The coating of lead arsenate with a metallic soap produces a spraying composition which spreads evenly and adheres to the foliage to a degree not hitherto attained with a spray mixture. Due to its adhesive quality it is practically unaffected by rain, thus resulting in a saving of material and a reduction in the number of applications necessary.

THE USE OF KEROSENE EMULSION IN CONTROL OF THE SCALE TOUMEYELLA SP. ON LOBLOLLY PINE

By E. W. HADLEY, *Southern Forest Experiment Station, New Orleans, La.*

In December, 1922, a serious infestation of loblolly seedlings by a species of scale insect was observed by the author in the seed beds of the Great Southern Lumber Company at Bogalusa, La. Practically every seedling in an area of about 100 square feet was attacked by the scale. The seedlings so infested were about nine months old and growing in very dense stands, over 100 per square foot. The scale insect at the time of discovery was in the dormant stage and protected by its waxy covering. Specimens of infested seedlings were collected and sent to the Bureau of Entomology where the scale was identified by Mr. Harold Morrison as a species of Toumeyella and the use of kerosene emulsion spray suggested as a means of control by Mr. William Middleton of the office of Forest Insect Investigations.

Scale infested seedlings from the area described above were transplanted to cut-over lands in January, 1923, and observed closely during the following season. A very small per cent of these was found alive at the final examination in October.

An examination early in August of the new 1923 seed beds showed a large per cent of the seedlings on practically the entire seed bed area (1000 square feet) of the Great Southern Lumber Company's nursery to be covered with emerging young of the scale Toumeyella. The Company was advised to spray at once with the summer strength solution of the kerosene emulsion formula ($^1/_3$ gallon emulsion to 2 gallons water) suggested by the Bureau of Entomology. There was some delay in having the area sprayed, and when the seed beds were finally treated late in August the insects had begun to form their protective coating. Probably as a result of this delay in control work the seedlings were badly devitalized by the scale, and spraying with summer strength was only partially effective. No chemical injury to seedlings was observable as result of this treatment. Some two weeks later when the

ineffectiveness of this spraying was noticed by Company employees the beds were given a second spraying with a much stronger solution (about twice that of the first used) which resulted in material chemical injury (leaf and terminal bud killing) to the seedlings with little effect on the insects. The leaf and bud killing occurred in large spots over the nursery and was probably due to the inability of the workmen to keep the solution thoroughly mixed. At the time of this spraying the scale had reached the adult stage. The production of more than one brood of young during a single season greatly increased the difficulties of control.

These results brought out the necessity for conducting systematic experimental sprayings to determine the strongest solution of kerosene emulsion that could be used on loblolly seedlings under one year of age without injury to the plants.

On July 3, 1924, five 4×5′ seed bed plats in the Great Southern Lumber Company's nursery at Bogalusa, containing good stands of three-months-old loblolly seedlings, 75 per square foot, were staked out for experimental sprayings.

A kerosene emulsion was prepared as follows: ½ gallon water, ¼ lb. laundry soap, 1 gallon kerosene. The soap was dissolved in boiling water, removed from the fire, and kerosene added. The mixture was stirred for five minutes until foamy. It was then diluted and applied as follows:

Plat No.	Quantity of emulsion used	Diluted with water	Amount of solution used per 20 sq. ft. seed bed
1	1/8 gal.	1 gal.	1/2 gal.
2	1/6 "	1 "	1/2 "
3	1/4 "	1 "	1/2 "
4	1/3 "	1 "	1/2 "
5	1/2 "	1 "	1/2 "

Results and conclusions:

On August 8, 1924, these plats were examined closely for evidences of chemical injury caused by the various strengths of spray solutions used. Seedlings in plats four and five which were sprayed with solutions of one part of kerosene emulsion to two and three parts water respectively were found alive but with a very noticeable discoloration of the needles on the upper part of the stem. Seedlings in plat 3, sprayed with a one to four solution showed only a very slight discoloration of needles. Seedlings in plats 2 and 1 treated with one to six and one to eight solutions respectively were entirely free from chemical injury.

After passing through a period of retarded growth practically all seedlings in plats 4 and 5 recovered.

Wholesale spraying in August of several thousand square feet of seed bed by the Great Southern Lumber Company with a one to four solution of kerosene emulsion and water resulted in occasional small patches of seedlings with discolored needles and very successful control of the scale insect. Commercial spraying of the same area later in the season with a one to six solution produced no discoloration of needles but was perhaps not quite as effective in controlling the insects. In all commercial sprayings with kerosene emulsion it was found very difficult to maintain the solutions at uniform concentration.

It is the writer's opinion that a solution of one part of kerosene emulsion to five parts of water will give the best results as a spray for the control of the scale insect Toumeyella on loblolly pine.

Scientific Notes

Postal Revenue for Grasshopper Control. The raising of money for insect control through increased postal rates is unique in the Annals of Economic Entomology. Stamp collectors in the United States were very much interested a few months ago by the fact that letters coming from Mexico bore an extra one centavo stamp. An explanation for this is found in the May, 1925, issue of the Scott's *Monthly Stamp Journal*. Owing to the enormous damage caused by grass hoppers in Mexico during the past few years, the President of that country issued a decree under which all domestic postal matter shall carry, in addition to the regular postage, a special one centavo stamp. The funds obtained from the sale of these stamps will be applied to the war on grasshoppers. Confirmation of this statement is contained in an announcement from the Department of Commerce that the Mexican interior postal tariffs on all letters and packages were increased by one cent during March.

J. W. McCOLLOCH.

Lunate Onion Fly, *Eumerus strigatus* Fall. Maggots of this species were received in 1911 in infested iris roots from Saratoga, accompanied by the statement that the tubers were eaten by grubs or borers. Collecting in the same garden last July resulted in finding a number of adult flies, the insect probably having maintained itself during the 14 year period and presumably longer. This introduced insect is evidently widely distributed in New York State, since supplementary collecting last July resulted in the capture of flies at Amsterdam, Schenectady, Albany, Greenville and Athens in the eastern section of the state and at Geneva in the central portion. None were found on iris collections at Rochester, East Aurora and Fredonia in the western section of the state. These negative records by no means indicate the absence of the species, since in the brief time available for collecting it was impossible to make an exhaustive search for the insect. In no instance this year were the flies definitely associated with material injury to the iris.

E. P. FELT

Cottony Peach Scale, *Pulvinaria amygdali* Ckll. A somewhat severe and extremely unusual outbreak of this insect in the peach orchards along the Lake Ontario shore was brought to notice in late June by Mr. L. F. Strickland of Lockport, he stating that the infestation extended as far east as Oswego. Examinations the latter part of August in peach orchards in the vicinity of Olcott showed a somewhat serious condition. There had been the preceding week or ten days a copious production of honeydew, and sooty fungus developing therein had discolored and even blackened much of the foliage and the fruit. The production of honeydew had practically stopped at the time of the examination, though specimens received later indicated that it had not entirely ceased. In some orchards the infestation was so severe that last year's wood was well festooned with the old scales. The infestation was so uniform in many of the orchards as to suggest local distribution by winds. Quince bushes were even more badly infested than the peach.

This is presumably an ephemeral outbreak due to unusually favorable climatic or other conditions. There appears to be no previous record of this insect having occurred in New York State. E. P. FELT

Evergreen Span Worm, *Nepytia contracta* Walker. A number of larvae identified by Dr. H. G. Dyar, of Washington, were collected on hemlock at Rhinebeck, N. Y. These were from trees 20 to 30 feet high growing along a public highway, though separated from it by a thick wall and in part by a row of large sugar maples with trunk diameters of some 18 inches. These hemlocks were on one side of a field well under the maples and according to the owner it was noticed a year ago last spring that many of the branches turned up and inward so that the leaves of the branchlets were in many cases upside down.

An examination July 21, 1925 resulted in finding many of these canker worms on the foliage. The upper third of the trees were dead or nearly so and the branches just below the dead area were in a greatly weakened condition and followed in this upturning referred to above. There were enough of the canker worms to suggest at least severe injury the present summer and also to lead one to believe that they might have been even more numerous a season or two before, when they probably fed on the upper portion of the trees. It seems quite possible that this feeding and nearly to complete defoliation for one or two seasons may have resulted in killing the upper parts of the trees and perhaps while this was in progress produced conditions which caused the limbs below the severely affected area to turn upward toward the light and assume the unnatural condition now observable. E. P. FELT

Longevity of the Adult Codling Moth. At Saticoy, California, in the spring of 1925 eight hundred codling moth larvae were gathered from bands that had been placed on walnut and apple trees the year before. In the most heavily infested walnut orchard an average of one larvae for two trees was obtained. The apple tree bands, however, were well supplied with larvae. An equal number of larvae were taken from walnut and from the apple.

These were placed in cocooning racks in order to observe the period of pupation. As the adults emerged they were placed in Petri cages. Each cage contained a female and, when available, a male. From the walnut tree larvae 141 males and 223 females developed. Eggs were deposited by 158 of these females.

The Petri cage consists of a glass Petri dish cover, four inches in diameter and at least one half inch deep, placed on a piece of cardboard (six ply, tough check) four and one half inches square.

In order to facilitate handling, the cages were placed in stacks of not more than ten in each. Small sponges were put in the cages as a means of supplying the moths with food. At least twice a week these sponges were soaked in a dilute solution of brown sugar and distilled water.

The daily record of each moth was noted on the cardboard. Since most of the eggs were deposited on the card they were easily counted. Each day the eggs deposited the previous day were rubbed off or else the card was set aside that the eggs might hatch and the incubation period be determined.

The average age of the overwintering brood adult was 28.8 days. The life of the male probably ends soon after copulation. In one case a male 39 days old died within 12 hours after copulation. An un-mated male lived for 63 days.

The following monthly mean temperatures in the laboratory were computed from the thermograph records for each two hours:

May 61.5 degrees. June 64.9 July 68.4

The individual records of 27 females living 39 days or over are tabulated below.

Date of Emergence	Number of days from emergence to 1st ovi-position	peak ovi-position	end of ovi-position	Death	Days of egg deposition	Total eggs	Max. laid in one day
May 13	25	33	39	42	5	6	2
" 21	17	32	37	39	16	84	13
" 22	7	36	38	40	8	27	9
" 24	3	24	47	50	23	75	8
" 27	25	29	51	57	9	26	11
" 30	3	30	43	44	25	194	65
" 13	14	28	45	54	18	40	5
" 18	2	18	37	41	17	73	18
" 22	8	19	38	42	17	134	16
" 22	3	39	41	55	7	13	4
" 23	22	28	40	45	10	103	27
" 23	13	23	44	45	21	145	23
" 24	3	33	43	45	20	56	7
" 27	11	32	45	46	17	105	16
" 27	12	49	55	57	33	185	16
" 30	7	8	38	44	18	65	14
" 30	11	11	11	49	1	4	4
June 6	23	41	46	47	19	83	18
" 9	14	27	46	48	22	132	25
" 10	3	35	48	51	22	93	14
" 10	13	18	27	40	8	22	8
" 10	7	37	41	42	24	153	18
" 10	16	16	31	43	6	11	5
" 14	4	7	34	41	17	61	17
" 13	9	40	45	46	20	55	10
" 16	2	9	36	43	15	68	12
July 17	32	60	64	66	17	37	5
Average	11.4	28.2	41.1	46.7	12.4	75.9	14.4

Note: The first six are from the apple and the remaining 21 from the walnut.

The relatively long life of the codling moth in the Saticoy district, while it causes an overlapping of the broods, apparently extends the egg deposition so that a few of the eggs laid by the overwintering brood moths are deposited too late to result in infested walnuts. It appears that most of the second brood larvae fail to mature on the walnut. The harvesting of the walnut crop commenced Sept. 14th. this year.

STANLEY E. FLANDERS, *Saticoy, California*

THE ROCKY MOUNTAIN CONFERENCE OF ENTOMOLOGISTS

The third Rocky Mountain Conference of Entomologists was held in Pingree Park, Colorado, August 17 to 22. Pingree Park is a mountain park about 54 miles westward and one mile higher than Fort Collins. This year's meeting was the best attended and said by all to be the most profitable and enjoyable meeting yet held. A total of 68 registered at the camp. Among these were 33 entomologists, representing 13 states. We were unfortunate in having some rainy weather the fore part of the week, which dampened some of the people but did not lessen their enthusiasm. In a way this proved a blessing as it gave us a good reason for getting to work early so that the last part of the week could be used more for pleasure. A brief sketch of the calendar of the week will give an idea of how the time was spent.

Monday:—While the advance guard had gone to the camp on Friday and Saturday and several visitors had gone up in their own cars on Sunday, a great many were to make the trip Monday morning. These arrived by noon or shortly after and the afternoon was taken in the many duties that must be performed to make a mountain camp reasonably comfortable. In the evening a short business meeting was held to discuss the work and play of the week. The following committees were appointed:

Program—J. E. Dudley, Chairman.

Entertainment and hikes—Miss Esther Gillette,Chairman.

Resolutions—Dr. Paul B. Lawson, Chairman.

The remainder of the evening was spent in getting acquainted and having a general good time.

Tuesday, forenoon:—First regular meeting was called at 9 A. M. Dr. Gillette, as Chairman, gave a few remarks welcoming the visitors and explaining the origin and aim of the conference. The Program Committee reported that due to the large number of subjects offered and to allow time for recreation and collecting, they were as far as possible, grouping subjects of kindred relation, and in some cases it would be necessary to handle several in the form of symposiums. Program given:

Corn Billbug—A. F. Satterthwait.

Bollworm and Boll Weevil Problems in Arizona—Chas. T. Vorhies.

A committee consisting of Gillette, Fluke, Beamer and Drake was appointed to suggest plans for publishing papers on the insect fauna of the Park and for publishing lists of insects taken.

Tuesday, afternoon:—

Pea Aphis Control in Wisconsin—J. E. Dudley.

Pea Aphis Enemies—C. L. Fluke.

Alfalfa Weevil in Colorado—J. H. Newton.

Alfalfa Weevil Conditions in Wyoming—C. L. Corkins.

Evening:—Codling Moth and Codling Moth Traps in Colorado—W. P. Yetter, Jr.

Onion Thrips—P. M. Gilmer.

The Black Field Cricket in South Dakota—H. C. Severin.

One hour in charge of the Entertainment Committee with "Yum Yum" Lawson starring.

Wednesday:—1:30 A. M. A porcupine appears in camp.

7:30—Bill Hayes fried pancakes for breakfast.

Program:—The Mexican Bean Beetle in Western Colorado—J. H. Newton.

The Mexican Bean Beetle in New Mexico—P. M. Gilmer.

Cucurbit Insects and their Control in Iowa—Dr. C. J. Drake.

Transmission of Cucurbit Mosaic—R. E. Wall.
A Recent Collecting Trip in Colorado—H. H. Knight.

Afternoon:—Symposium on Apiculture.
Soap Formaldehyde Treatment of Diseased Combs—C. L. Corkins.
Apicultural Inspection Work in Wyoming—C. H. Gilbert.
Suggestions on Prospective Federal Control of American Foul Brood —R. G. Richmond
The Wax Moth and Arsenical Poisoning of Bees—F. B. Paddock.

Evening:—Symposium on the Teaching of Entomology, lead by W. P. Hayes, C. L. Fluke, and P. B. Lawson.
An old-fashioned taffy pull.

Thursday:—The entire day was left open for the horseback trip to Hallet's Glacier, for hikes, collecting, etc. The Glacier trip was somewhat of a disappointment as a storm so engulfed the mountain that the guide would not attempt to cross the Glacier. Those on the trip experienced an August snow and sleet storm. The prize collection of the day consisted of an even 60 speckled beauties taken by C. R. Jones. It is needless to say that all were on time for breakfast next morning.

Evening:—
The Life History of the Muscle Parasite of Sheep, *S. tenella*, J. W. Scott.
Colorado Flowers Illustrated—Miss Caroline Preston.
The Virginia Reel, etc., etc.

Friday, forenoon:—Open for collecting, fishing, etc.

Afternoon:—Meeting for reports of committees, discussion of future work and meetings, and election of officers. It was unanimously voted to hold a meeting next year at the same place, the exact time to be decided later, but this time will necessarily be the latter part of August. The officers elected for the ensuing year were C. P. Gillette, Chairman; C. J. Drake, Vice-Chairman; G. M. List, Secretary; C. R. Jones, Treasurer.

Evening:—Symposiums on insecticides and dusting and spraying apparatus, led by I. L. Ressler, R. L. Shotwell, G. S. Langford and J. E. Dudley, followed by State Stunts.

Saturday forenoon was taken in breaking camp and packing equipment. Many were loth to leave and did not get started until after lunch, but all arrived in Fort Collins before dark. The following is a list of entomologists attending the conference: F. C. Hottes, J. L. Hoerner, Wm. P. Hayes, J. E. Dudley, Jr., R. L. Shotwell, A. F. Satterthwait, G. S. Langford, W. P. Yetter, Jr., Paul B. Lawson, I. L. Ressler, C. T. Vorhies, H. C. Severin, K. D. Arbuthnot, R. E. Wall, H. H. Knight, C. H. Gilbert, F. B. Paddock, W. J. Brown, R. G. Richmond, C. H. Linsley, M. A. Palmer, C. A. Bjurman, G. M. List, Paul M. Gilmer, C. P. Gillette, C. L. Corkins, C. L. Fluke, Jr., R. H. Beamer, J. W. Scott, S. A. Johnson, C. J. Drake, C. R. Jones and J. H. Newton.

GEORGE M. LIST, *Secretary*

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

OCTOBER, 1925

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, at $2.50 per page for all matter in excess of six printed pages; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

Separates or reprints, if ordered, when the manuscript is forwarded, will be supplied to authors at the rates given below. Note that the number of pages in a reprint may be affected somewhat by the make-up, and that part of a page is charged as a full page. Carriage charges extra in all cases. Shipment by parcel post, express or freight as directed.

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There are men who desire to attend every session of the annual meetings and listen to a reasonable amount of discussion of all papers of both the American Association of Economic Entomologists and the Entomological Society of America and in addition certain special groups desire time for their peculiar problems. Six days and usually only five days are all that are available and not all the members can give as much time as this. Conditions are somewhat like those of a university. Each individual must limit his activities. President Gossard, in a letter printed elsewhere in this issue discusses several plans at some length and requests a careful consideration of the entire subject and preparation for constructive discussion at our next meeting. The organization of branches and their functions, closer coöperation with the Entomological Society of America through some redistribution of sectional activities and simultaneous meetings of different sections are three important matters. The primary object of all our meetings is to discuss the numerous problems constantly arising. There should be a place for the public presentation and discussion of papers and also an opportunity for personal conferences, the latter sometimes very important. Increase in membership and the number of papers to be presented has resulted in congested programs and very limited discussion at the larger meetings at least. Are there practicable remedies? What limitations or restrictions are best? Every member is strongly urged to study the President's letter and to attend the next meeting prepared to take part in a constructive discussion of our policy in the future.

Current Notes

Dr. L. O. Howard, Chief of the Bureau of Entomology, has returned from his trip to Europe.

Mr. H. L. Dozier, formerly of the Bureau of Entomology, has been appointed Entomologist of the Delaware Agricultural Experiment Station.

According to *Experiment Station Record*, Dr. Joseph M. Ginsberg has recently been appointed Biochemist in entomological investigations at the New Jersey Station.

Dr. Herbert T. Osborn, formerly connected with the Bureau of Entomology, and now located in Mexico, visited the Washington office on July 28.

Prof. E. H. Strickland, of Edmonton, Alberta, through the courtesy of Mr. Seamans, is making the Lethbridge Laboratory his summer headquarters for wireworm investigations.

Mr. Curtis Benton of the Bureau of Entomology has recently been transferred from Stored-Product Insect Investigations to European Corn Borer Control, Cleveland, Ohio.

Prof. H. A. Ballou, of the West India Agricultural College, Trinidad, West Indies, and H. L. Frost, of Arlington, Mass., were recent visitors at the Gipsy Moth Laboratory.

According to the *Experiment Station Record*, Dr. Hugh Glasgow of the New York State Station has been assigned to an investigation of insect problems of canning crops.

According to the *Official Record*, Prof. A. E. Stene has resigned as Director of the Rhode Island Extension Service to take up horticultural research in the Experiment Station.

According to *Science*, Dr. Vernon Kellogg, Secretary of the National Research Council, was one of the Americans attending the recent meeting of the British Association for the Advancement of Science at Southampton.

Dr. Ralph L. Parker of Cornell University has been appointed Assistant Professor of Entomology at the Kansas State Agricultural College, the position made vacant by the resignation of Dr. J. H. Merrill, July 1.

Mr. L. S. McLaine, in charge of Foreign Pests Suppression, Entomological Branch, Canadian Department of Agriculture, visited the Japanese Beetle laboratory at Riverton, N. J., July 23–25, and also investigated the Oriental peach moth situation.

Mr. H. G. Hudson, Strathroy, Ont., spent considerable time during the latter half of July in the corn borer infested district of Ontario. He reports a heavy infestation of the insect in most sections visited.

From July 10 to July 14 a migrational flight of Japanese beetles occurred. During this time it was necessary to embargo the movement of all farm produce out of the city of Philadelphia. A similar flight occurred July 28 to August 1, 1924.

Mr. N. J. Atkinson, of the Saskatoon laboratory, has been awarded a Bursary by the Canadian Research Council to study various phases of the red-backed cutworm problem at the University of Saskatchewan, this winter.

Professor Franklin Sherman resigned to take effect September 15, as State Entomologist and Chief in Entomology at the North Carolina Exepriment Station and Department of Agriculture, to accept a similar position at Clemson College, S. C.

Dr. W. H. Larrimer, who has been in charge of the Lafayette, Ind., laboratory of the Bureau of Entomology, has been appointed Entomologist in charge of the Division of Cereal and Forage Crop Insects of the Bureau of Entomology.

Mr. U. C. Loftin, formerly of the Bureau of Entomology and the Federal Horticultural Board, was a recent visitor at the Sugarcane Insect Laboratory at New Orleans, La. Mr. Loftin is now agricultural manager of a cotton plantation in Mexico.

Mr. C. F. Stahl, formerly of the Bureau of Entomology, visited the Bureau on his way to Riverside, Calif., to spend a short vacation before returning to Baragua, Cuba, where he is now connected with the Tropical Plant Research Foundation.

In the Entomological Branch, Canadian Department of Agriculture, Mr. George Hopping has recently been appointed Temporary Junior Entomologist, Vernon Laboratory. Mr. G. P. Walker was promoted, July 1, from Junior Entomologist to Assistant Entomologist, and will investigate orchard insects in New Brunswick.

Mr. F. H. Shirk, a graduate student of the Kansas State Agricultural College, has accepted the position of Junior Entomologist with the Division of Cereal and Forage Insect Investigations of the Bureau of Entomology. He is located at the Toppenish, Washington, Laboratory.

Mr. Theron P. Remy is now in the employ of the Texas Oil Company with headquarters at Houston, Texas, and will study the insecticidal value and possibilities of certain oil preparations. He recently visited New York City and New Haven, Conn.

Mr. Edgar W. Davis, a graduate student of the Kansas State Agricultural College, has accepted the position of Junior Entomologist with the Division of Truck Crop Insect Investigations of the Bureau of Entomology. He is stationed at the Toppenish, Washington, Laboratory.

Prof. F. L. Washburn, collecting Polynesian insects for the University of Minnesota, which institution has granted him a year's leave of absence for that purpose, writes from Tahiti, where he has been working, that he sails very shortly for the Tuamotu Archipelago. Later he will collect on Raiatea and other islands of the Society Group.

The Bureau of Entomology has announced the following resignations: C. A. Thomas, Riverton, N. J., to accept a position at the Pennsylvania State College; J. B. Gill, to enter commercial work; F. J. Brinley, to enter the employ of the American Cyanamid Company, New York City.

Prof. A. P. Jacot of Shantung Christian College, Shantung, China, is spending the year in the United States and will study at Columbia University. His parents live in Monroe, Connecticut, and he has twice called at the Entomological Department of the Station in New Haven.

Mr. A. B. Baird of the Chatham, Ont., Laboratory, reports that specimens of the imported European corn borer parasite, *Exoristes roborator* have been recovered in the field for the first time. As only a comparatively small number have been liberated in the district this result is very promising.

According to the *Official Record*, continued reports are received by the Bureau of Entomology to the effect that the general destructive prevalence of cut worms, extending from Maine to Oregon and south to the Gulf, continues. Practically every State from which reports were received mentioned their serious abundance.

Mr. Ralph L. Parker has accepted appointment to the Bureau of Entomology, for a temporary period to study the problem of the poisoning of honeybees by the use of calcium arsenate for control of the boll weevil. Mr. Parker will conduct his investigations at the Florence, S. C., Station.

Mr. Leroy M. Gates, formerly of the Department of Entomology, University of Nebraska, has accepted a position with the Kansas State Entomological Commission. Mr. Gates will assist with the inspection of orchards and nurseries. His office will be with the Department of Entomology at the Kansas State Agricultural College.

Professor H. E. Woodworth, formerly of the College of Agriculture, Los Banos, Philippine Islands, Prof. Glenn W. Herrick of Cornell University, and Dr. Herbert T. Osborn of the United Sugar Company of Mexico, formerly of the Hawaiian Sugar Planter's Association, Honolulu, were recent visitors at the Japanese beetle laboratory, Riverton, N. J.

Messrs. W. N. Keenan, of Ottawa, an Entomologist of the Canadian Department of Agriculture, and Charles Ross, of Ottawa, of the Canadian Department of Trade and Commerce, spent several days during the first part of July at Melrose and different parts of Massachusetts in preparing a motion picture of the gipsy moth.

Mr. H. Caracciola, of Trinidad, recently called at the Division of Insects, U. S. National Museum, to become acquainted with some of the workers and to arrange exchanges of insects. Mr. Caracciola has corresponded with the Bureau for 35 years, knew many of the older entomologists, and remembered well the late Dr. C. V. Riley.

A conference of Federal and State regulatory officials was held on July 21 at Cleveland, Ohio, in connection with the enforcement of European corn borer clean-up regulations, and was attended by L. H. Worthley and D. J. Caffrey, of the Arlington Mass., laboratory, and W. H. Larrimer, of the Lafayette, Ind., laboratory of the Bureau of Entomology.

Dr. A. C. Baker of the Bureau of Entomology has been detailed by the Secretary of the Department to the Personnel Classification Board, where he will be engaged for some time in the preparation of specifications covering the character of work and the required qualifications for positions in the field of entomology and those of a related character.

Prof. Geo. A. Dean resigned as Senior Entomologist in charge of the Division of Cereal and Forage Crop Insects, Bureau of Entomology, on June 1, 1925, to resume his position as head of the Department of Entomology of the Kansas State Agricultural College, Manhattan, Kansas. He has been appointed Collaborator in the corn borer work, effective July 1.

Mr. H. E. Gray at Lethbridge, Alberta, resigned his position as Seasonal Junior Entomologist on June 30th, in order to become a candidate in the local competition advertised by the Civil Service Commission to fill the position of Temporary Assistant Entomologist made vacant by the resignation of Mr. W. Carter. Mr. Gray was appointed to this position effective July 1.

Mr. A. G. Dustan, Entomological Branch, Canadian Department of Agriculture, was absent from the Wolfville laboratory throughout the most of June, making a field and truck-crop insect survey in east and north sections of Nova Scotia, the island of Cape Breton, Prince Edward Island and part of New Brunswick, returning to Ottawa, July 13, to take charge of truck-crop insect investigations.

Members of the Bureau of Entomology have recently received advanced degrees as the result of graduate studies, as follows: W. H. Larrimer, D.Sc., C. A. Weigel, Ph.D., Ohio State University; W. J. Phillips, D.Sc., University of Virginia; P. W. Mason, Ph.D., George Washington University; O. I. Snapp, M. S., Mississippi Agricultural and Mechanical College; Robert C. Burdette, M.S., University of Maryland; C. M. Packard, M.S., University of California.

Dr. F. C. Craighead of the Bureau of Entomology left Washington, D.C., June 19, on a field trip to visit stations and sections of the country where important studies of forest insects are to be made or control work is to be carried on this year. He will be accompanied by Dr. E. J. Kraus in his visits to Asheville, N. C., Bogalusa, La., and the Kaibab National Forest.

Mr. H. L. Seamans, Entomological Branch, Canadian Department of Agriculture, spent the first week of June in British Columbia, where he rendered very important assistance to Messrs. Buckell and Vroom in connection with the grasshopper campaign. Dr. J. R. Parker of Montana Experiment Station, at Bozeman, visited Mr. Seamans and accompanied him to British Columbia to study the movements of the immature stages of the grasshoppers in the British Columbia outbreak.

Mr. R. A. Cushman of the Bureau of Entomology left on June 22 for Halsey, Nebr., where he will liberate parasites of the tip moth. Mr. Cushman has devoted considerable time during the past spring to studying parasites of the tip moth around Washington, and has made a large collection. It is hoped that the liberation of these parasites will aid in the control of the tip moth, which is doing much damage in the Nebraska National Forest.

Dr. J. M. Swaine, Associate Dominion Entomologist, left Ottawa early on July 13 for Quebec and the Maritime Provinces, where he visited the Fredericton and Annapolis laboratories, and later proceeded to Halifax and took a boat to St. Johns, Newfoundland, to study an outbreak of the spruce bark-beetle, *Dendroctonus piceaperda* Hopk. He visited the Henrysburg district, Quebec, June 29, in company with the Deputy Minister of Agriculture and Mr. L. S. McLaine to witness spraying operations against the gipsy moth.

Dr. E. J. Kraus, Professor of Applied Botany in the University of Wisconsin, has been appointed a Field Assistant of the Bureau of Entomology for the summer. Dr. Kraus was connected with the Bureau in the years 1907–1909. He will study certain tree conditions which appear to have an important bearing on the various barkbeetle problems, and will visit stations in several of the areas where barkbeetles are epidemic or most active. Dr. Kraus spent several days in Washington before leaving with Dr. Craighead for Asheville, N. C., where his field investigations will begin.

The second annual Shade Tree Conference was held in Boston and vicinity August 21 and 22. An exhibit was made at the gipsy moth parasite laboratory at Melrose Highlands by Mr. Burgess and his staff and a demonstration of a newly devised power spray outfit was given close by. Some of the Entomologists present at the laboratory were: A. F. Burgess, S. S. Crossman, J. N. Summers, H. L. Blaisdell, C. E. Hood, C. W. Minott, D. F. Barnes and others of the laboratory staff; W. E. Britton, New Haven, Conn.; W. O. Hollister, Kent, Ohio; H. L. Frost, Arlington, Mass.; A. E. Stene, R. A. Sheals and Harry Horovitz, Providence, R. I.; W. A. L.

Bazeley was present at the opening session and Messrs. Frost, Burgess and Bazeley were on the local committee.

Mr. H. G. Crawford, Entomological Branch, Canadian Department of Agriculture, was absent from Ottawa June 1–4 in western Ontario, visiting the entomological laboratories at Strathroy, Chatham and Wheatley. Visits were also made to Essex, St. Thomas and Union. On July 15, he left for western Canada, intending to visit the laboratories connected with the division. Mr. Crawford was joined at Brandon, Manitoba, by Mr. Norman Criddle, who accompanied him on his trip to British Columbia to review the grasshopper situation there. At Salmon Arm, B.C., they were met by Mr. E. R. Buckell of the Vernon laboratory. Mr. Crawford intends visiting the Nicola, Agassiz, Vancouver, Victoria, and Vernon laboratories while in British Columbia.

The following appointments in the Bureau of Entomology have recently been announced: temporary field assistants, H. L. Weatherby, Birmingham, Ala.; D. M. DeLong, Columbus, O.; C. H. Martin, Estancia, N. Mex.; C. H. Griffith, Toppenish, Wash.; W. H. Beerman, Riverton, N. J.; J. W. Nuttycombe, Charlottesville, Va.; Adan Celaya, Yuma, Ariz.; Gilbert J. Haeussler, Junior Entomologist, Riverton, N. J.; Ralph L. Parker, Florence, S. C.; Dr. E. J. Kraus, Asheville, N.C.; R. F. Sazama, Junior Entomologist, blueberry maggot investigations in Maine; J. E. Bussart, Vincennes, Ind.; Franklin T. Cowan, Junior Entomologist, Billings, Mont.; R. C. Brown and H. M. Tietz, Junior Entomologists, Melrose, Mass.; E. W. Davis, Junior Entomologist, Toppenish, Wash.; T. W. Allen and L. A. Curet, temporary field assistants, Ala.; Dr. Geo. W. Martin and Prof. O. G. Anderson, temporary appointments, Riverton, N. J.

Dr. R. W. Leiby has been appointed Chief in Entomology in the Experiment Station and the North Carolina Department of Agriculture and State Entomologist, in place of Prof. Franklin Sherman, resigned. Dr. Leiby had been senior assistant in the Division for ten years. Recently Mr. W. V. Reed, formerly State Entomologist of Georgia, and lately with the Federal Horticultural Board, has been appointed assistant in the Division to have charge of Inspections in place of T. B. Mitchell, who resigned to teach at State College. Other members of the entomology division now include Messrs. J. C. Crawford, J. A. Harris, and C. S. Brimley.

Mr. Arthur Gibson, Dominion Entomologist, returned to Canada from England, on July 12, sailing on the S. S. Doric. Mr. Gibson stated that at the Imperial Entomological Conference, held in London, June 8–18, there was an excellent attendance of entomologists from all over the British Empire. At one of the sessions, Mr. Gibson gave an illustrated address on the entomological services of Canada. He visited several English educational institutions where entomology is being developed and also held conferences with various government officials. At the dinner given by the Colonial Office at the close of the Conference, Mr. Gibson responded to the toast to the Delegates. On July 21, at Cleveland, Ohio, Mr. Gibson attended an imporant conference of state and federal officials engaged in European corn borer work. He later visited the several entomological laboratories in southern Ontario.

Mr. William Middleton, of the Bureau of Entomology, recently visited Grassdale, the estate of Admiral D. W. Taylor, near Waldrop, Va. He took with him some eggs of the elm leaf beetle parasitized by *Tetrastichus xanthomelaenae* Rond., for liberation at Westover, an adjoining estate badly infested by the elm leaf beetle. This material

was recently received from Madrid, Spain, from S. M. Dohanian, of the Gipsy Moth and Brown-Tail Moth Investigations. When liberated the material was in excellent condition despite the long voyage to this country and the subsequent necessary delay in liberation, for the parasites were in process of emergence and those which had emerged were very active. Mr. Middleton had taken this parasitized material to Westover on a previous visit, June 15, but at that time no eggs or adults of the elm leaf beetle were present and therefore it was useless to leave the parasites.

Dr. M. D. Leonard, of Cornell University, has accepted a position in charge of field work for the Florida Agricultural Supply Company of Jacksonville, Florida. On October 1 he entered upon his new duties which will consist of extensive experiments, demonstrations and educational work on insect pests and plant diseases with the large citrus and vegetable growers throughout the State. Before leaving Cornell, Doctor Leonard completed copy for the New York State List of Insects, of which he has been editor-in-Chief. His address will be care of Florida Agricultural Supply Company, Orlando, Florida.

Plans are being perfected in co-operation with the American Wood Preservers' Association to have a termite-proof building erected at Ancon, Canal Zone. This building is to be a model for frame structures in the Tropics, and, among other features, will embody concrete foundations and metal termite shields. All woodwork and furniture will be treated with various chemical preservatives. With the co-operation of the National Lumber Manufacturers' Association, press notices have been sent out as to the advisability of modifying building codes in various cities to prevent damage by termites. This program has been taken up by the Associated Press and will doubtless receive wide publicity. Notices have also been sent to city engineers in 150 cities. W. P. Flint, Entomologist of the State Natural History Survey Division of Illinois, is planning co-operative experiments with the State office of rural architecture to develop methods of termite-proofing buildings. These methods are to be available in the Mississippi Valley, where a large amount of damage by termites occurs.

According to the *Official Record*, three different species of gipsy moth parasites not yet established in the moth-infested area of New England were liberated in that region this season by entomologists of the department. Eight distinct species had been established there previously. Some of the European tachinid parasites of the gipsy moth liberated were obtained from several parts of Europe last summer and were successfully hibernated in the hibernating cages in the laboratory yard at Melrose Highlands, Mass. One small colony of mated adults of another gipsy moth larval parasite also was liberated this spring. These flies were obtained by collecting the cocoons of the pine sawfly, one of the hibernating hosts of the species in southern Poland early this spring. The cocoons were taken to Bremen, Germany, where the parasites were reared and shipped to the Melrose laboratory as puparia. A strong colony of about 1,500 adults of a small wasplike parasite has also been liberated in an area which is badly infested by the gipsy moth this season. These parasites were obtained by men sent to southern Poland and parts of Czechoslovakia, where they were very abundant this year. The spring colonization of the *Anastatus* parasite of gipsy moth eggs, which is well established in the inside moth-infested territory, has been completed. More than 2,500,000 of these parasites were liberated during the spring outside the area where the species is now common.

Apicultural Notes

Government foulbrood inspections in England are not made free of charge, but for a fee of about ten dollars per day, with a minimum charge of one-half this amount.

European investigators have found the honeybee involved in the transmission of yeasts found in the nectar of certain species of plants, the yeasts being carried on the bee's proboscis.

Mr. W. J. Nolan of the Bee Culture Laboratory of the Bureau of Entomology was on the program of the beekeepers' meeting held August 12, during Farmers' Institute Week at Blacksburg, Virginia.

The annual meeting of the Georgia Beekeepers' Association was scheduled to be held at Valdosta, Ga., September 14 and 15. Mr. W. C. Barnard, Glennville, Ga., is secretary-treasurer of this Association.

According to the Indiana *Beekeepers' Letter* for August, Mr. Jay Smith, the queenbreeder, possesses a queen already in her ninth year. It is further reported that her colony stored 120 pounds of comb honey last year.

The Wyoming Beekeepers' Association, under the leadership of Prof. C. L. Corkins, has undertaken to establish queen bee mating stations somewhat along the lines of those in use for some years in Switzerland, and other European countries.

Doctor Morgenthaler reports that, in Switzerland, in certain colonies suffering from an unusually high death rate of adult bees, not only was *Nosema apis* present, but also a species of amoeba was found encysted in the Malpighian tubules.

According to *Gleanings in Bee Culture*, Prof. V. G. Milum of the University of Wisconsin has recently been appointed to the position in the beekeeping division of the Department of Entomology of the University of Illinois, made vacant by the resignation of Prof. Wallace Park.

What was termed the "first apicultural congress" ever held in Chile took place during May, and resulted in the formation of a national beekeepers' association. No bee journals being published in Chile as yet, the *Revista de Apicultura* of Argentina has a special department devoted to its neighbor.

Recent visitors at the Bee Culture Laboratory were: Mr. V. M. Argo, who is doing entomological work for the State of Maryland; Dr. Robert Griggs, Prof. of Botany at George Washington University; Mr. T. M. N. Lewis of the G. B. Lewis Company, manufacturers of bee supplies; Dr. E. F. Phillips, of Cornell University; and Prof. E. N. Cory, of Maryland.

Mr. Jas. I. Hambleton, in charge of the Bee Culture Laboratory of the Bureau of Entomology, participated during September in beekeepers' meetings held in Tennessee, North Carolina, Georgia and Alabama. One of the meetings, that at Charlotte, North Carolina, on September 10–11, was a union meeting of beekeepers from both North and South Carolina.

The following temporary employees of the Bee Culture Laboratory of the Bureau of Entomology have resigned: August 19, Miss Winifred S. Hull, Assistant Scientific Aid; September 7, Mr. Lloyd M. Bertholf, Junior Biologist; and September 18, Mr. Carlton E. Burnside, Junior Biologist. Miss Hull is resuming undergraduate work at Vassar College, while Mr. Burnside returns to his graduate studies at the University of Michigan. Mr. Bertholf is Professor of Biology at Western Maryland College.

Aeroplane dusting for forest insects in a certain region in Germany, on one occasion this year, resulted disastrously to colonies of honeybees in the vicinity. Chemical analysis showed the presence of the poison dust in pollen but not in honey from the afflicted hives. This is explained on the grounds that any bees gathering nectar poisoned by such dust would be killed before getting back to the hive, whereas poisoned pollen could be gathered with immunity.

Dr. A. P. Sturtevant, of the Bee Culture Laboratory of the Bureau of Entomology, participated in the meetings held in connection with the bee disease inspection tour by Wisconsin beekeepers from August 10–15. The tour was highly successful, as many as 35 autos being in line at one time, while the attendance at some of the meetings ranged from 100 to 150 persons. The route included Janesville, Fort Atkinson, Watertown, Milwaukee, Fond du Lac, Sheboygan Falls, and other places.

Dr. J. H. Merrill, Associate Professor of Entomology, Kansas State Agricultural College, resigned July 1 to take active charge of his fruit farm and apiaries, in Massachusetts. During the 13 years that Dr. Merrill was with the Kansas State College he published a large number of valuable papers. Several of his articles on Apiculture were published in foreign journals. With his resignation, the Kansas State College and Experiment Station lost, not only one of its best teachers and research men, but also a loyal and faithful supporter of all College activities.

The Bee Culture Laboratory of the Bureau of Entomology has announced that in co-operation with the Bureau of Agricultural Economics, the work on standard color grades for extracted honey is completed. A type of grader has been perfected which quickly and accurately determines the color grade of any sample of honey. The active principle of this grader consists of a wedge-shaped vessel for containing the sample of honey to be graded; this, in turn being compared with an inversely placed wedge of amber glass. The two wedges are viewed simultaneously through a slit which permits light to pass through from the rear. When the color of the honey and that of the glass wedge match, the color grade of the honey is indicated on an appropriate scale calibrated with the standard commercial grades of extracted honey. These grades will be recommended as standard for the United States by the Bureau of Agricultural Economics.

Pacific Slope Notes

Dr. E. C. Van Dyke, of the University of California, recently made a brief visit to the Toppenish, Wash., laboratory of the Bureau of Entomology.

The Dried Fruit Insect Laboratory of the Bureau of Entomology, J. C. Hamlin in charge, at Fresno, California, was recently moved from 1584 Ferger Avenue to 712 Elizabeth Street.

Dr. R. N. Chapman, Professor of Entomology, University of Minnesota, recently visited the Toppenish, Wash., laboratory of the Bureau of Entomology and discussed the sugar-beet leafhopper work with Mr. Carter.

Mr. M. C. Lane, of the Toppenish, Wash., laboratory of the Bureau of Entomology, visited southern Idaho recently in connection with wireworm investigations. While there he held a conference with Claude Wakeland, Entomologist of Idaho.

Dr. C. A. Weigel, Sub-tropical Fruit Insect Investigations of the Bureau of Entomology, has recently been making a survey of the bulb situation on the Pacific Coast with reference to injurious insects, and visited the Alhambra, Calif., laboratory on July 2.

Mr. W. W. Yothers, who has been stationed at Orlando, Florida, for some years, is making an extended visit in California, where he is making a special study of the citrus industry, particularly the insect pests and methods of controlling them.

The following members of the Bureau of Entomology attended the meetings of the Pacific Slope Branch at Portland, Ore., in June: R. E. Campbell, J. C. Elmore, David Dunavan, C. M. Packard, C. C. Wilson, M. C. Lane, Thos. R. Chamberlin, L. P. Rockwood, Dr. E. A. Back.

Dr. E. A. Back of the Bureau of Entomology has recently returned from a trip to the Pacific coast, where he visited the Bean Weevil Laboratory at Alhambra, Calif., and the Dried Fruit Insect Laboratory at Fresno, Calif., for consultation with the men in charge of the various phases of the work.

Mr. V. L. Wildermuth, of the Tempe, Ariz., laboratory of the Bureau of Entomology, visited northeastern Utah July 9–24, where, in company with Dr. I. M. Hawley, State Entomologist of Utah, an investigational trip of some 800 miles was made by automobile into the Uintah Basin for a survey of the alfalfa seed chalcis situation.

Horticultural Inspection Notes

Mr. L. M. Scott, Associate Chief, Plant Quarantine Inspection Service, recently made a trip to Cincinnati to inspect a consignment of grape fruit received from Cuba.

Mr. Clarence E. Drumheller has been appointed to the position of Junior Plant Quarantine Inspector, with the Federal Horticultural Board, with headquarters in New York City.

Messrs. H. L. Sanford, A. J. Bruman, and L. L. Spessard, of the Federal Horticultural Board, with headquarters in Washington, were recently sent to New York to assist in the bulb inspection during the heavy shipping season.

Mr. Nile M. Border has been appointed to the position of Junior Plant Quarantine Inspector, with the Federal Horticultural Board, to fill the vacancy caused by the transfer of Mr. A. G. Harley from New York to Baltimore.

Miss Grace Sandhouse has been appointed to the position of Senior Scientific Aide, with the Federal Horticultural Board. She received her training in the University of Colorado, and holds the degrees of Bachelor of Arts and Master of Arts from that institution.

Mr. G. F. Moznette will shortly start on a trip through Cuba for the Federal Horticultural Board, to make a further survey of insect conditions on the Island. Information is desired in regard to freedom from pests, particularly the fruit flies, attacking fruits and vegetables offered for import to this country.

Owing to the danger of importing the Oriental peach moth from the United States, the Canadian Department of Agriculture has adopted Regulation No. 14 (Foreign) effective June 22. This regulation places a quarantine against the importation of

fresh peaches and peach nursery stock from the states of Wisconsin, Illinois, Missouri, Arkansas, Mississippi and the area east of those states, and further requires that such shipments from other states, must be accompanied by a certificate of origin.

A number of insects which might be of considerable importance as pests if introduced and established in this country, have recently been intercepted at the various ports by inspectors of the Federal Horticultural Board. Some of these are: *Epicaerus cognatus* Champ., in potatoes from Mexico; *Conotrachelus sp.*, in avocadoes from Mexico; *Anastrepha sp.*, in Sapodillas from Venezuela; *Anastrepha fraterculus* Wied., in mangoes from Porto Rico and Jamaica; *Anastrepha ludens*, in mangoes from Mexico; *Ceratitis capitata* Wied., in apples from Spain; and, *Pectinophora gossypiella* Saund., in cotton bolls from Turkey.

Dr. C. L. Marlatt has just returned from a trip to France and Spain, where he went at the request of the Department of State, to correct misunderstandings regarding the purpose of the Quarantines regulating the entry of fruits and nursery stock into the United States. Through conferences with officials and growers in these two countries, Dr. Marlatt was able to leave the correct impression that the restrictions against imported plants and plant products were put into effect solely for the purpose of preventing the introduction into the United States, of new and dangerous plant pests, and that these restrictions had no relation whatever to mere commercial protection.

Notes on Medical Entomology

According to *Science*, Sir Ronald Ross opened the new building of the British Mosquito Control Institute at Hayling Island on August 31.

Dr. H. G. Dyar, U. S. National Museum, has received an interesting collection of mosquitoes from W. H. W. Comp, of the Public Health Service, Honduras. This is the first collection of mosquitoes from that locality to be received by the museum.

Mr. Hugh E. Wallace, of the malaria mosquito force of the Bureau of Entomology, who has been attending the University of Minnesota during the past school year, has completed the requirements for a master's degree. On July 1 he returned to duty at Mound, La.

Messrs. E. W. Laake, W. E. Dove and H. M. Brundrett of the Bureau of Entomology from the Dallas, Texas station, and Dr. R. C. Roark of the Bureau of Chemistry, from the Washington, D. C., office co-operating with the Bureau of Entomology, spent three months during the summer at Reagan Wells in southwest Texas conducting field tests with fly repellents against the screw worm fly, *Chrysomyia macellaria*, which was unusually abundant in the dry Frio canyon and caused heavy infestations among range animals. During the period of their investigation a case of screw worms infesting the ear of a small Mexican child was encountered and closely observed. The child was almost constantly under the care of a trained nurse and recuperated somewhat, but finally, after about six weeks died, apparently as a direct result of the injury caused by the worms, which had reached maturity before they were discovered by the mother.

European Corn Borer Tour and Conference, Ohio, Michigan, and Ontario, Canada, Sept. 29 to Oct. 1

Tuesday was devoted largely to an examination of the somewhat thickly infested territory in the Lake Bono region some 16 miles east of Toledo, Ohio. The infestation is of but four years standing, yet a number of fields show 30 per cent stalk infestation and one nearly 64 per cent, there being an average of 1–2 larvae per stalk. The experimental plots to obtain data on varietal susceptibility and the effect of the time of planting on infestation attracted much attention, as well as the work with parasites. A demonstration of two specially designed corn cutting and binding machines constructed through the cooperation of the Ohio State University Farm Mechanics Laboratory, the Ohio State Department of Agriculture, the Ohio Agricultural Experiment Station and the Bureau of Entomology, U. S. Department of Agriculture, aroused keen interest. Both machines cut the stalks within an inch of the surface of the ground and one is designed so that the essential parts may be attached to any corn binder at a cost which should not exceed twenty-five or thirty dollars.

The most startling conditions were seen Wednesday in portions of Essex and Kent counties, Ontario, Canada. There is an area of about 400 square miles where a 100 per cent stalk infestation is well nigh universal, the early planted corn having from 10 to 40 larvae per stalk and a cob infestation of from 75 to 90 or even 100 per cent. One field characterized as fairly representative showed approximately a 50 per cent loss as estimated by a member of the party. This condition was common in dent corn. One field, part dent, part flint, averaged 40 and 33 larvae per stalk respectively and was a total loss. This extraordinarily severe infestation followed a year of exceptional abundance and the infestation this season was undoubtedly greatly increased by a fifty to seventy-five per cent reduction in the area planted.

Over 100 participated in the tour and attended the conference, the latter held Thursday at Windsor, Ont. The general features of the situation were discussed briefly by Messrs. Caffrey, Crawford, Huber, McLaine, Worthley, Truax, Call, Willetts, Felt and Woodbury, Dean Curtiss of Iowa presiding. Those responsible for calling the conference were highly gratified at the general interest manifested and were especially pleased that so many of the uninfested states were represented. A standing committee was created to look after all phases of this important work, the chairman being given discretionary powers to add to the membership. The committee is as follows: C. F. Curtiss, W. C. Coffey, L. E. Call, H. W. Mumford, C. G. Woodbury, C. V. Truax, F. P. Willets and E. A. Burnett.

Uninfested states were represented as follows: Indiana, J. J. Davis, and A. T. Wianco, Lafayette, F. N. Wallace and H. F. Dietz, Indianapolis: Illinois, W. P. Flint, P. A. Glenn, E. W. Lehman, Geo. Still, C. M. Woodward, Urbana; R. J. H. De Loach, Chicago: Iowa, Dean C. F. Curtiss, C. J. Drake, Ames: Kansas, Director L. E. Call, G. A. Dean, Manhattan: Missouri, W. C. Ethridge, Columbia: Wisconsin, Director F. B. Morrison, Madison: Minnesota, Dean W. C. Coffey, St. Paul: Nebraska, W. W. Burr, M. H. Swenk, Lincoln.

The official workers and infested states representatives follow: W. R. Walton and W. H. Larrimer, Washington, D. C.; C. G. Woodbury, Secretary American Canners Association, Washington.

Massachusetts, D. J. Caffrey, D. W. Jones, Arlington, R. H. Allen, L. H. Worthley, Boston.

New York, E. P. Felt, Albany, Hugh Glasgow, Geneva, Kenneth E. Paine, Jamestown, H. N. Bartley, Silver Creek.

Pennsylvania, F. P. Willetts, Commissioner of Agriculture, C. H. Hadley, F. L. Guyton, Harrisburg, H. E. Hodgkiss, H. N. Worthley, State College, O. C. Tritt, Erie, A. A. Mathewson, Meadville; E. G. Tifft, Franklin.

Ohio, C. V. Truax, Director of Agriculture, Herbert Osborn, N. E. Shaw, D. M. De Long, Geo. R. Eastwood, N. W. Brownfield, Richard Faxon, Ed. A. Silver, J. E. McClintock, M. T. Meyers, E. W. Mendenhall, R. D. Barden, H. L. Flackler, C. W. McIntyre, T. H. Parks, Geo. B. Grove, W. D. Griffith, W. D. Leach, O. E. Reed, Chas. H. Reese, Columbus, Director C. G. Williams, H. A. Gossard, J. S. Houser, Robert M. Slater, L. L. Huber, L. E. Thatcher, Wooster, C. O. Lanabee, E. G. Brewer, W. H. Lloyd of the Ohio Farmer, Cleveland, C. H. Sears, Chillicothe, William Ellis, Napoleon, M. E. Wygant, Painesville, August E. Miller, Chillworth, H. J. Speaker, F. W. Poos, Morris R. Myers, L. H. Patch, Sandusky, Enos M. Rowe, Geo. Sherman, T. L. Thompson, Findlay, J. S. Carroll, Talbot, Jesse E. Whousetler, Defiance, R. S. McKay, Owensville, L. B. Palmer, Palaskala, J. E. Bragg, Castalia, E. F. Swany, Prospect, C. R. Neiswander, Oak Harbor, E. O. Williams, Toledo, E. H. Bond, Napoleon, Chas. Fray, Bucyus, C. E. Towle, Elyria.

Michigan, L. R. Taft, R. H. Pettitt, Geo. E. Starr, B. F. Kindig, J. F. Cox, Lansing, Fred. W. Hanshaw, G. V. Branch, E. J. Leinhouts, Bert Wermuth, Detroit, W. P. Hartman, Grand Rapids, C. D. Bolander, Howell.

Canada, L. S. McLaine, H. G. Crawford, Ottawa.

Ontario, Lawson Caesar, Guelph, H. F. Hudson, Strathroy, J. Harold Fox, Lambeth, G. H. Ficht, London, A. D. Baird, J. W. Parker, Chester W. Smith, C. S. Thompson, R. E. White, Chatham.

THIRTY-EIGHTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

The 38th annual meeting of the American Association of Economic Entomologists will be held at Kansas City, Mo., Dec. 29, 1925 to Jan. 2, 1926.

The meeting place in the city has not yet been decided upon but it is understood that the affiliated societies meeting with the A. A. A. S. will be within a few blocks of one another.

The Section of Quarantine and Inspection will hold their meeting on Tuesday, Dec. 29; the Section of Apiculture on Wednesday, Dec. 30. There will be a joint session and Symposium on Parasitism with the Entomological Society of America on Wednesday afternoon, Dec. 30.

Thursday, Dec. 31, in the forenoon will be the opening session of the General Association at which time business will be transacted and the annual address of the President delivered. The sessions for the reading of papers by members will continue until Saturday, Jan. 2. During the latter day the final business will be transacted.

Hotel headquarters will be at the Baltimore, 12th and Baltimore Ave. As the hotels are likely to be crowded during convocation week, members are urged to secure accomodations early by corresponding direct with the management.

Applications for membership should be filed with the Secretary as early as possible and should be accompanied with fee of $4.00. Application blanks can be secured from the Secretary or the Chairman of the Membership Committee.

C. W. COLLINS, *Secretary*, Melrose Highlands, Mass.